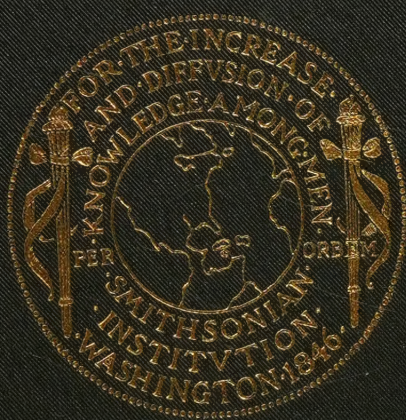


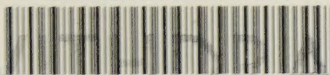




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The scientific publications of the National Museum consist of two series, Proceedings and Bulletins.

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The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

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RICHARD RATHBUN,

*Acting Secretary of the Smithsonian Institution.*

JANUARY 22, 1907.



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# DESCRIPTIONS OF NEW ISOPOD CRUSTACEANS OF THE FAMILY SPHÆROMIDÆ.

By HARRIET RICHARDSON,

*Collaborator, Division of Marine Invertebrates.*

In order to give fuller diagnoses of some genera recently established in my monograph on the Isopods of North America and to illustrate some of the parts which were taken as a basis of generic distinctions I have prepared the following paper, in which I also offer descriptions of a few new species and one new genus. Five of the species are from South America, two are from Japan, one comes from Cape Town, Africa, and the locality of another is unknown. All, with the exception of *Isocladus magellanicensis*, are in the collection of the United States National Museum.

## Genus TECTICEPS Richardson.

Body oval and somewhat flattened. Head subquadrangular, broader anteriorly than posteriorly with the anterior and lateral margins produced, concealing the antennæ.

The antennæ, which are entirely hidden, extend backward and lie under the epimeral plates at the sides of the thorax. The first and second pairs of legs in the male are subchelate; the first pair terminate in a large hand and finger, bearing a small hook; the second pair terminate in a more irregularly shaped hand. All the other legs are simple in structure. In the female only the first pair of legs are subchelate.

The terminal segment of the abdomen is triangular and entire, and is pointed at the extremity. The uropoda are double-branched and lateral, and resemble closely those of the genus *Sphæroma*. Both branches are well developed and similar in shape.

This genus differs from the genus *Ancinus* of Milne Edwards—

1. In having uropoda with two branches instead of one.
2. In having the abdomen entire and not truncate at the tip.
3. In the prominent projection of the anterior and lateral margins of the head.
4. In the concealment of the antennæ, which are very conspicuous in *Ancinus*.

The type species of the genus is *Tecticeps alascensis* Richardson.

## TECTICEPS ALASCENSIS Richardson.

*Tecticeps alascensis* RICHARDSON, Proc. Biol. Soc. Washington, XI, 1897, pp. 181-183, figs. 9-12; Proc. U. S. Nat. Mus., XXI, 1899, p. 837; Ann. Mag. Nat. Hist. (7), IV, 1899, p. 181; Bull. U. S. Nat. Mus., No. 54, 1905, pp. 276-278, figs. 286-289.

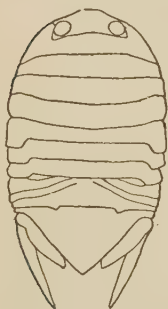
*Localities*.—North of Amak Island; off Cape Menchikoff; south of Hagemeister Island; North Head, Akutan Island; off Bristol Bay; Alutian Islands, off Unimak Island; Kamchatka; off Sturup Island, Kurile Islands, Okhotsk Sea; latitude  $60^{\circ} 16'$  north, longitude  $167^{\circ} 41'$  west; Bering Sea, west of Pribiloff Islands, between Pinnacle and Ulakhla, Unalaska; Bering Sea, off Nunivak Island.

*Depth*.—9-106 fathoms.

U. S. National Museum collection.

The outline of the body is oval. The surface is quite smooth, but covered with little points of depression. Length 16 mm.; width 10 mm.

FIG. 1.—TECTICEPS ALASCENSIS. MALE,  $\times 2\frac{1}{2}$ .



The head is large, twice as long as any one of the thoracic segments. The anterior margin is produced in a way to conceal the antennae, as are also the antero-lateral margins, making the anterior portion of the head in front of the eyes much broader than the posterior portion, and forming very acute antero-lateral angles. This frontal margin forms a very broad obtuse angle with its apex in the median line. On either side of this apex to the antero-lateral angle this portion of the head is somewhat depressed. The antennae are not conspicuous, lying concealed beneath the frontal margin of the head. The first pair extend to the posterior angle of the first thoracic segment; the flagellum is composed of ten articles. The second pair reach the middle of the second segment; the flagellum consists of twelve articles. The eyes are dorsally situated on the posterior half of the head in both sexes.



FIG. 2.—TECTICEPS ALASCENSIS. *a*, MANDIBLE. *b*, MANDIBULAR APPENDAGE.  $\times 5\frac{1}{2}$ .

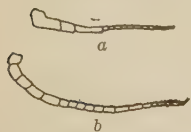


FIG. 3.—TECTICEPS ALASCENSIS. *a*, ANTENNA OF FIRST PAIR. *b*, ANTENNA OF SECOND PAIR.  $\times 5\frac{1}{2}$ .

The thoracic segments are about equal in length. The first one extends laterally around the posterior portion of the head, forming a broad plate at the side of the segment. The epimera of all the segments are about twice as broad as long, with the exception of those of the fifth segment, which are nearly square and very conspicuous.

The first segment of the abdomen has three suture lines, and its posterior margin projects down at the sides over the terminal segment. The terminal segment is triangular and has



a very pointed extremity, more acute in the male than in the female. The uropods differ considerably. The inner one is broad and tapering and does not reach the tip of the abdomen. The outer one is slender and sharply pointed, and extends beyond the abdomen. In the female the outer branch is not longer than the inner branch.

The first pair of legs are subchelate, as are also the second pair in the male. In the first pair the propodus is large and oval in shape,



FIG. 5.—*TECTICEPS ALASCENSIS*. *a*, LEG OF FIRST PAIR OF MALE.  $\times 5\frac{1}{2}$ . *b*, LAST TWO JOINTS OF SAME.  $\times 10\frac{1}{2}$ . *c*, LEG OF SECOND PAIR OF MALE.  $\times 5\frac{1}{2}$ . *d*, LEG OF THIRD PAIR.  $\times 5\frac{1}{2}$ . *e*, LEG OF SIXTH PAIR.  $\times 5\frac{1}{2}$ . *f*, LEG OF SEVENTH PAIR.  $\times 5\frac{1}{2}$ .

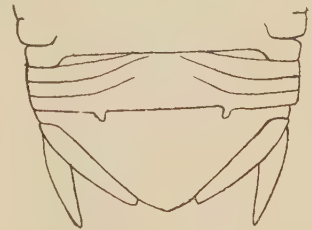


FIG. 4.—*TECTICEPS ALASCENSIS*. ABDOMEN OF FEMALE.  $\times 4\frac{1}{2}$ .

and bears in the palma a row of stiff bristles at regular intervals and pointing obliquely in the same direction, while a thick row of fine cilia, pointing obliquely in the opposite direction, cross these almost at right angles. The dactylus terminates in a single hook, at the base of which two smaller hooks are situated. In the legs of the second pair the propodus is irregular in shape with an indication of a rudimentary pollex. There are no hairs or bristles in the palma. The legs of the third, fourth, and fifth pairs present nothing unusual in structure, but resemble the ambulatory legs common to this family. In the sixth and seventh pairs the structure is the same as that of the preceding legs of the third, fourth, and fifth pairs, but with an increasing disproportion in the length of the propodus and dactylus. In the seventh pair of legs these joints, but more especially the propodus, attain a size most conspicuous for their length. The propodus becomes over  $3\frac{1}{2}$  times longer than the carpus which immediately precedes it.

The color varies from dark brown to yellow, more or less dotted with black. In the darker specimens the epimera and the uropods are almost white with scattered spots of black. Other specimens are brown, with markings of red and some are bluish-gray in color tinged with brown or orange.

## TECTICEPS CONVEXUS Richardson.

*Tecticeps convexus* RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, pp. 837-838, fig. 15; Ann. Mag. Nat. Hist. (7), IV, 1899, pp. 181-183; American Naturalist, XXXIV, 1900, p. 223; Bull. U. S. Nat. Mus., No. 54, 1905, pp. 278-280, figs. 290-291.

*Locality*.—Monterey Bay, California.

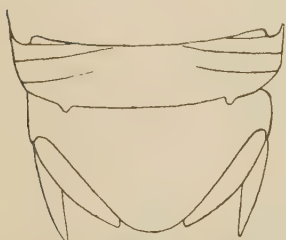
*Depth*.—30 feet, in sandy mud.

U. S. National Museum collection.

The body is oval and somewhat flattened. The surface is smooth. The color is light yellow, with markings of brown.

The head has the anterior margin much broader than the posterior margin, and produced in front, but not wholly concealing the basal articles of the first pair of antennae, and somewhat raised, forming two small convex elevations. The antero-lateral margin

FIG. 6.—TECTICEPS CONVEXUS. ABDOMEN OF FEMALE.  $\times 4\frac{1}{2}$ .



is likewise produced, forming an acute angular projection, which extends in a lateral direction beyond the post-lateral margin of the head. The eyes are dorsally situated in a median transverse line in both sexes. The first pair of antennae, with a flagellum of 16 articles, extend to the posterior angle of the third thoracic segment. The second pair of antennae, with a flagellum of 13 articles, extend to the middle of the fourth thoracic segment and exceed by one article the length of the first pair of antennae. Both pairs of antennae are disposed to lie concealed under the broad epimeral plates of the thoracic segments.

The thoracic segments are subequal in length. The first segment has its antero-lateral angles produced around the anterior portion of the head, forming a broad plate at the side of the segment. The epimera are almost twice as broad as long; those of the fifth segment extend downward, with the anterior margin straight, making the



FIG. 7.—TECTICEPS CONVEXUS. a, HEAD.  $\times 5\frac{1}{2}$ . b, ABDOMEN AND LAST THORACIC SEGMENT.  $\times 2\frac{1}{2}$ .

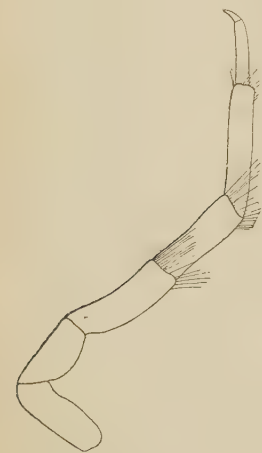


FIG. 8.—TECTICEPS CONVEXUS. SEVENTH LEG OF MALE.  $\times 4\frac{1}{2}$ .

length and breadth about equal and forming almost square epimera; in the epimera of the sixth and seventh segments the anterior margins are in the same direction as the posterior margins, which extend downward.

The first segment of the abdomen has three suture lines, and its posterior margin is produced in two small points, one on either side of the median line, about equidistant from it and the lateral margin of the segment. The terminal segment is widely rounded posteriorly. The inner branch of the uropoda is of nearly equal width throughout its length and is rounded at its extremity; the outer branch is slender and sharply pointed. Both branches are of nearly equal length, and neither extend beyond the tip of the abdomen. This is true of both sexes.

The first pair of legs have the propodus dilated and the dactylus reflexible. The propodus is large and oval in shape. In the legs of the second pair the propodus is irregular in shape, dilated with reflexible dactylus in the male and simple in the female. The legs of the other five pairs are similar in structure, ambulatory, and show a gradual increase in length.

This species differs from *T. alascensis* in having longer antennæ and antennulæ; in having a rounded terminal segment, which in that species is very pointed but more acute in the male than in the female; in having the outer branch of the uropods in both sexes as short as the inner, while in that species it is much longer in the male but not in the female; in having only a gradual increase in the length of the legs, which in that species show such marked disproportions in the propodus of the sixth and seventh pairs; and in the position of the eyes, which in this species are situated in the median transverse line of the head, while in *T. alascensis* they are placed in the posterior half of the head.

This species was considered by Hansen, who had not examined any specimens, to be a synonym of *T. alascensis*.<sup>a</sup> Having sent specimens, a male and female of both species, to Doctor Hansen, I received a courteous and speedy recognition of his error. Doctor Hansen states in his letter that "both species are well founded," and that "*T. convexus* is a fine species; especially the differences in the shape of the first and second hand and seventh thoracic leg in the males of both species are really interesting."

#### Genus CYMODOCE Leach.

Seventh segment of thorax not produced backward in any process.

Abdomen composed of two segments, the first of which is without mesial process. Terminal abdominal segment in both sexes with a



FIG. 9.—TECTICEPS CONVEXUS. SECOND LEG OF MALE.  $\times 43$ .

<sup>a</sup>Quarterly Journal of Microscopical Science, XLIX, Pt. 1, October, 1905, pp. 133-134.

notch in center of which is a median process or lobe. Endopod of uropod well developed. Exopod not capable of folding under endopod.

Exopod of third pleopod always two-jointed.

Fourth and fifth pleopods with endopods thick, fleshy, with transverse folds; exopods two-jointed.

Maxillipeds with the second, third, and fourth articles of the palp produced into lobes.

Mouth parts in female metamorphosed.

The type of the genus is *Cymodoce truncata* Leach.

CYMODOCE ORNATA, new species.

Head large, nearly twice as broad as long,  $3\frac{1}{2}$  mm.: 8 mm., rounded anteriorly, with a small median point separating the antennæ. Eyes round, post-laterally situated. The first pair of antennæ extend to the posterior angle of the first thoracic segment; the flagellum is composed of ten to eleven articles. The second pair of antennæ reach fully to the posterior margin of the fourth thoracic segment; the flagellum consists of from eighteen to nineteen articles.



FIG. 10.—CYMODOCE ORNATA. ABDOMEN OF MALE.  $\times 6\frac{1}{2}$ .

The segments of the thorax are subequal in length, the first being somewhat longer. The epimera are posteriorly produced into very acute angles, gradually becoming less acute, the last one being quite rounded.

The first segment of the abdomen is composed of four coalesced segments, indicated by three suture lines, the third of which forms a ridge in the center.

The sides of this segment are produced into rounded lobes, provided with fine hairs, and overlap the terminal segment. Two small tubercles on either side of the median line are situated on the posterior margin. The terminal segment is thickly tuberculated. At the base are four tubercles, situated in a transverse row. Below these are four others, similarly situated, but farther apart, and differing in size, the two center ones being more prominent. Below this row, and placed in the median line, is a small triangularly shaped prominence, in the center of which is a tubercle. The posterior margin of this segment has a quadrangular excavation, in which there is a central tooth which does not extend beyond the lateral teeth formed by the excavation. The entire margin is fringed with thick hairs.

The uropods, which are about equal in length, extend considerably beyond the extremity of the abdomen. The inner branch is rounded on the inner post-lateral angle and ends in a spinelike process at the outer post-lateral angle; the external one is lanceolate, with upper inner surface very concave; the outer margins of both are fringed with hairs.



The color of the body is brown, more or less marked with black spots. The lower half of each segment of the thorax and the tubercles of the abdomen are a dull yellow.

This species is closely allied to *C. longistylis* Miers,<sup>a</sup> but differs in the absence of tubercles on the thoracic segments, and in the disposition of those on the terminal abdominal segment.

Locality unknown. The type and only specimen, a male, is in the U. S. National Museum, Cat. No. 32242.

**CYMODOCE JAPONICA, new species.**

Body  $7\frac{1}{2}$  mm. wide;  $17\frac{1}{2}$  mm. long.

Head large, longer than the second thoracic segment, its anterior margin ridged and sinuated and produced in a large median point. The basal joint of the peduncle of the first pair of antennæ is large and elongated; the second joint is small and short; the third joint is long and slender. The flagellum is composed of nineteen articles and extends to the posterior angle of the first thoracic segment. The flagellum of the second pair of antennæ is composed of twenty-four articles and reaches the posterior angle of the third thoracic segment.

The thoracic segments are about equal in length. The epimera are broader than long and are produced into acute angles, becoming more rounded and obtuse in the three posterior ones.

The first segment of the abdomen has two suture lines on either side indicating coalesced segments, and a transverse line indicating still another coalesced segment. Its posterior margin bears two tubercles, pointing downward and on either side of these a small tooth overlapping the terminal segment. The last segment is posteriorly excavated, with a large and broad median tooth within the excavation. This median tooth has a truncate extremity, while the lateral teeth, formed by the sinus, are more acute and rounded. Two small tubercles are situated at the base of this segment in the line with those of the first segment. Following these, and in the same line, are two very large tubercles. A longitudinal furrow or groove in the median line is formed by these two sets of tubercles. The inner branch of the uropoda is truncate at the extremity, is of equal breadth throughout its length, and does not extend beyond the extremity of the abdomen. The outer branch is rounded on the inner side, but has a straight thickened outer edge, terminating acutely; it is about as long as the inner branch.

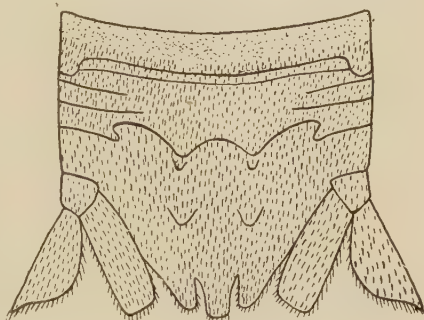


FIG. 11.—CYMODOCE JAPONICA. ABDOMEN AND LAST THORACIC SEGMENT OF MALE.  $\times 4\frac{1}{2}$ .

<sup>a</sup>Zool. Coll. of Alert, 1884, p. 305.

The whole surface of the body is granulated and covered with minute hairs, which increase in number and length on the abdomen and the edges of the uropods, where they form a thick fringe. The color is a light brown.

This species can not be identified with *Cymodoce pilosa* Edwards<sup>a</sup> from the Mediterranean, and from the "east and west coast of Algeria," for it differs in a number of points. The surface of the entire body is granulated, while in Milne Edwards species only the posterior half is covered with granules. There is no elevation at the extremity of the longitudinal groove, as in *C. pilosa*, as described by Edwards and figured by Lucas.<sup>b</sup> Moreover, two tubercles are found on either side of the groove in the present species, while in *C. pilosa* there is but one mentioned and figured. Lastly, the uropods do not extend a great deal beyond the extremity of the abdomen, as in *C. pilosa*, but reach the extremity only. It differs also from *Cymodoce aculeata* Haswell in the different arrangement of the tubercles on the terminal abdominal segment. The species is founded on three specimens, all males, from Hakodate Bay, Japan, which are in the collection of the U. S. National Museum.

*Types*.—Cat. No. 32243, U.S.N.M.

**CYMODOCE AUSTRALIS, new species.**

Body ovate, 3 mm. : 6 mm.

Head wider than long, with the front marginate and produced in a small, median point. The eyes are large, composite, and situated in the post-lateral angles. The first pair of antennæ have the first article oblong, longer than wide, and produced at the outer distal angle in a small truncate process; the second article is small, oval in shape, about one-third as long as the first; the third article is narrow, elongate, about one and a half times as long as the second. The flagellum is composed of about fifteen joints. The first antennæ extend to the posterior angle of the first thoracic segment. The second pair of antennæ, with a flagellum of about seventeen articles, extend to the posterior margin of the third thoracic segment.

The first segment of the thorax is longer than any of those following and has the post-lateral angles produced backward. All the following segments are crossed transversely by a carinated ridge. The epimera are not distinctly separated, but faint lines of depression indicate the place of coalescence. The lateral parts of the segments have the posterior angles produced in narrow pointed processes directed posteriorly.

The abdomen is composed of two segments and is broader than the thorax, although dorsally it does not show any increase in breadth.

<sup>a</sup> Hist. Nat. des Crust., III, 1843, p. 213.

<sup>b</sup> Explorations Scientifiques de l'Algerie, Atlas, 1849, pl. vii, fig. 8.

The first segment has suture lines indicating other partly coalesced segments. On the posterior margin are two prominent tubercles, one on either side of the median line, directed backward as two points. The second or terminal segment terminates in three teeth, the median tooth completely filling the notch, of which the other teeth form the outer angles. The median tooth is not longer than the lateral teeth and is acute at the apex. At the base of the segment are two small tubercles in a transverse series just below the large tubercles of the preceding segment and situated a little outside of them. There are two other small tubercles just below this series in another transverse row and situated a little within the two upper tubercles. A transverse row of four large tubercles is placed below this second series. Just above the median tooth of the posterior margin and below the last series of four tubercles is a small median tubercle.

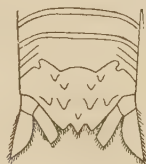


FIG. 12.—CYMODOCE AUSTRALIS. ABDOMEN AND LAST THORACIC SEGMENT OF MALE.  $\times 6\frac{1}{2}$ .

The inner immovable branch of the uropods reaches but little beyond the lateral teeth of the posterior margin of the terminal abdominal segment. It is posteriorly transversely truncate and has the sides parallel. The outer branch is nearly twice as long as the inner branch, is pointed at the extremity, and is leaf-shaped.

The entire surface of the abdomen is thickly tuberculate. The posterior margin of the terminal segment and the branches of the uropods are beset with hairs.

The specimen described is a male and is the type and only specimen. It was taken by the U. S. Bureau of Fisheries steamer *Albatross* off Cape St. Roque, Brazil, at a depth of 20 fathoms, among broken shells, and is preserved in the U. S. National Museum, Cat. No. 32244.

**CYMODOCE MERIDIONALIS, new species.**

Body with the sides almost parallel,  $4\frac{1}{2}$  mm.: 10 mm.

Head wider than long, and produced in a small median point. Eyes large, composite, and situated in the post-lateral angles. The first pair of antennæ have the first article oblong, nearly twice as long as wide; the second article is small, oval, and less than half the length of the first; the third article is as long as the second, but narrower, and is twice as long as wide. The flagellum is composed of seventeen articles, and extends to the post-lateral angle of the first thoracic segment. The second pair of antennæ, with a flagellum of twenty-two articles, extends to the post-lateral angle of the third thoracic segment.

The first segment of the thorax is longer than any of the others. The epimera are not distinct from the segments. They are laterally produced in narrow processes. The first segment has the post-lateral angles also produced.

The first segment of the abdomen has two suture lines on either side, indicating other coalesced segments. The terminal segment has a very deep median notch, the lateral angles being rather acute. Within the emargination, and completely filling it, is a large triangular median tooth, broad at the base and ending in a very sharp spine. This median

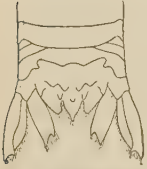


FIG. 13.—CYMODOCE  
MERIDIONALIS.  
ABDOMEN AND  
LAST THORACIC  
SEGMENT OF MALE.  
× 43.

tooth extends considerably beyond the lateral angles. At the base of the segment is a series of four tubercles situated in a transverse line. Below this row and outside of it are two prominent tubercles, one on either side. Below this transverse row of two tubercles is another row of two tubercles, one on either side of the median line, and situated closer together than the two preceding tubercles. At the base of the median tooth within the terminal notch is a small median tubercle. Both branches of the uropoda extend beyond the abdomen. The inner branch is twice as long

as wide, with sides nearly parallel and posteriorly obliquely truncate, with a spine at the outer and inner post-lateral angles. The outer branch is leafed-shaped and longer than the inner branch, and terminates in a spine. There is also another spine on the outer margin near the extremity.

The type and only specimen, a male, comes from off Cape St. Roque, Brazil. It was taken by the U. S. Bureau of Fisheries steamer *Albatross* at a depth of 20 fathoms, among broken shells, and is in the U. S. National Museum, Cat. No. 32245.

**CYMODOCE BRASILIENSIS, new species.**

Body ovate, more or less contractile, 4 mm.: 8 mm.

Head wider than long, with the front produced in a small median point. Eyes small, composite, and situated in the post-lateral angles. The first pair of antennæ have the first article oblong, about twice as long as wide; the second article is short and small and is one-third as long as the first article; the third article is narrow and elongate and about twice as long as the second article. The flagellum is composed of fifteen articles, and extends to the post-lateral angle of the first thoracic segment. The second pair of antennæ, with a flagellum of eighteen articles, extends to the posterior margin of the fourth thoracic segment.

The first segment of the thorax is longer than any of those following. The epimera are not distinctly separated on any of the segments. The post-lateral angles of the first segments are produced backward. The lateral parts of the following segments are posteriorly produced in narrow processes.

The abdomen is wider than the thorax, but this increase in width is not apparent in a dorsal view. The first segment has suture lines indicating other partly coalesced segments. It is produced at either



side in a small point, overlapping the terminal segment. The terminal abdominal segment has two large elevations or prominences on the convex basal part, one on either of the median line, the two being separated by a furrow. The terminal part of the segment has a median notch, which is completely filled by a large, triangular lobe, rounded at the apex and slightly exceeding in length the lateral angles, which are truncate posteriorly. The uropods do not extend beyond the lateral angles of the terminal segment of the abdomen. The branches are about equal in length, the outer, movable branch being capable of folding under the inner branch. The inner branch is truncate at the extremity, with a slight excavation about the center. The inner post-lateral angle of the outer branch is rounded, the outer post-lateral angle being acute.



FIG. 14.—CYMODOCE BRASILIENSIS. ABDOMEN AND LAST THORACIC SEGMENT OF FEMALE.  $\times 6\frac{1}{2}$ .

The specimen described is a female.

Four perfect specimens and one imperfect specimen come from off Cape St. Roque, Brazil. They were collected by the U. S. Bureau of Fisheries steamer *Albatross*, at a depth of 20 fathoms, among broken shells.

The types are in the U. S. National Museum, Cat. No. 32246.

#### CYMODOCE AFFINIS, new species.

Body ovate, a little more than twice as long as wide, 8 mm.:  $17\frac{1}{2}$  mm. Head transverse, twice as wide as long,  $3\frac{1}{2}$  mm.: 7 mm., with the front marginate and produced in a small median point. The eyes are large, composite, and posteriorly situated. The first pair of antennæ have the first article elongate, about twice as long as wide; the second article is small and less than half the length of the first; the third is narrow, about one-fourth the width of the first article, and elongate, being about two and a half times as long as wide. The flagellum is composed of about sixteen articles and does not extend to the post-lateral angle of the first thoracic segment, but to the posterior margin of that segment. The second pair of antennæ, with a flagellum of nineteen articles, extend to the post-lateral angle of the first thoracic segment.

The segments of the thorax are subequal, with the exception of the first, which is about twice as long as those following. The post-lateral angles of the first segment extend backward. The epimera of the six following segments are not distinct from the segments, but faint lines indicate the place of union. The lateral parts of these segments are drawn out in narrow triangular processes.

The abdomen is composed of two segments, the first of which has three suture lines on either side indicating partly coalesced segments.

The terminal abdominal segment is acutely pointed, with a small lateral tooth on either side, which does not extend to the tip of the large, median terminal tooth. The uropoda are shorter than the terminal segment and do not extend beyond the apex of the lateral teeth. The outer movable branch is capable of folding under the fixed inner branch and is not longer than that branch. Both branches are acutely pointed at the outer post-lateral angles. The inner is obtusely pointed on the inner post-lateral angle; the outer branch is rounded at this point. On the convex portion of the terminal abdominal segment, half-



FIG. 15.—CYMODOCE AFFINIS. ABDOMEN OF FEMALE.

way between the base and the extremity are two small, low tubercles or elevations, one on either side of the median line.

I place this species in *Cymodoce* with some hesitation, because the specimen, which is a female, has not the mouth parts metamorphosed as is usual with the females in this genus, according to Hansen's recent definition.

This species is very similar to *Sphaeroma granulata* Edwards from unknown locality, according to Edwards, and from "the east and west coast of Algeria," according to Filhol.

A single female specimen comes from Hakodate Bay, Japan.

*Depth*.—9 fathoms, in gravel.

*Type*.—Cat. No. 9346, U.S.N.M.

#### Genus ZUZARA Leach.

Last thoracic segment in the male with a slender mesial process produced backward. Abdomen composed of two segments. Terminal abdominal segment in female "somewhat produced; in the male strongly produced with a pair of lateral notches, so that the mesial part is shaped as a process narrowed at the base."

Branches of the uropods in the male are large, broad plates.

Maxillipeds with the second, third, and fourth articles of the palp produced into lobes.

Exopod of third pleopod two-jointed. Pleopods of the fourth and fifth pairs have the endopods thick, fleshy, with transverse folds, the exopods two-jointed.

The type of the genus is *Zuzara semipunctata* Leach.

#### ZUZARA INTEGRAL Haswell.

*Zuzara integra* HASWELL, Proc. Linn. Soc. N. S. Wales, VI, 1881-82, pp. 186-188, pl. III, fig. 6.

Body 14 mm. long; 8 mm. wide, increasing gradually in width toward the posterior extremity.

The head is wider than long, 2 mm.:  $5\frac{1}{2}$  mm. The anterior margin is produced in a small median point. The first pair of antennæ have the first article of the peduncle dilated; the second article is half as

long as the first and narrower; the third article is twice as long as the second and is slender; the flagellum is composed of 23 articles and extends to the posterior margin of the first thoracic segment. The second pair of antennae extend to the posterior margin of the third thoracic segment; the flagellum is composed of 18 articles. The eyes are large and composite and are post-laterally situated.

The first segment of the thorax is nearly twice as long as the following segments which are subequal. The epimera are produced laterally in processes which have rounded extremities. They are not separated from the segments. The seventh thoracic segment is produced backward in a long median process, with truncate extremity, which extends beyond the first abdominal segment and some distance over the terminal abdominal segment. In the female this process is much shorter, being more in the form of a triangular tubercle.

The first segment of the abdomen is short and has three suture lines on either side indicating partly coalesced segments. The terminal abdominal segment in the male has the sides converging toward the posterior extremity, which has a shallow quadrangular excavation, with a long median process extending some distance beyond the post-lateral angles of the segment. The fixed, inner branches of the uropoda are very large and broad, and surround the posterior part of the abdomen, meeting the produced median process on either side. The outer branches are long and broad, leaf shaped, and extend some distance beyond the inner branches. In the female, the terminal abdominal segment is triangular, with the apex produced in a very acute point. The branches of the uropoda are similar in shape to those of the male, but are not as long or as broad, and the inner branches do not extend to the median point of the terminal segment. The outer branches are but little longer than the inner branches.



FIG. 17.—ZUZARA INTEGRA. ABDOMEN AND LAST TWO THORACIC SEGMENTS OF FEMALE.  $\times 2\frac{1}{2}$ .



FIG. 16.—ZUZARA INTEGRA. ABDOMEN OF MALE.  $\times 2\frac{1}{2}$ .

The legs are all similar and ambulatory.

A large number of individuals of both sexes was collected in rock pools, Halletts cove, St. Vincent Gulf, Australia, by Edgar J. Bradley. The specimens are in the U. S. National Museum, Cat. No. 32247.

#### Genus ISOCLADUS Miers.

Last thoracic segment in the male with a slender median process produced backward. Abdomen composed of two segments. Terminal abdominal segment similar in both sexes, without notch.

Branches of the uropoda in the male are large, broad plates.

Maxillipeds with the second, third, and fourth articles of the palp produced into lobes.

Exopod of third pleopod two-jointed.

Pleopods of the fourth and fifth pairs have the endopods thick, fleshy, with transverse folds, the exopods two-jointed.

The type is *Isocladus armatus* (Milne Edwards).<sup>a</sup>

**ISOCLADUS MAGELLANENSIS, new species.**

Body less than twice as long as wide, 4 mm.:7 mm. Head wider than long, with the front marginate and produced in a small median point. The eyes are small, composite, and situated in the post-lateral angles of the head. The first pair of antennæ have the first article a little longer than wide; the second article is somewhat shorter than the first—about half as long; the third is one and a half times longer than the second, and narrower. The flagellum is composed of 11 articles and extends to the middle of the second thoracic segment. The second pair of antennæ, with a flagellum of 13 articles, extend to the posterior margin of the third thoracic segment.

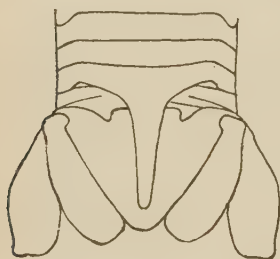


FIG. 18.—*ISOCLADUS MAGELLANENSIS*.  
ABDOMEN AND LAST THREE THORACIC SEGMENTS OF MALE. N. 9½.

The first segment of the thorax is longer than any of the six following segments. The seventh segment is produced in the middle in a long, backwardly directed process, which extends almost to the tip of the terminal abdominal segment. The epimera are not distinct from the seg-

ments, but are produced post-laterally in narrow processes.

The abdomen is composed of two segments, the first of which has suture lines at the sides, indicating other coalesced segments. The terminal segment is triangulate, with the apex rounded. The branches of the uropoda are alike in size and shape and are subequal in length. Each is nearly three times as long as broad, with the extremity roundly truncate. All the legs are ambulatory.

This species is close to *Isocladus spiniger* (Dana), but differs in the much wider exopod of the uropoda, which is not acuminate and curved outward at the tip, in the more rounded apex of the endopod of the uropoda and in the longer process of the first abdominal segment.

Only one specimen, a female, comes from Mayne Harbor, Owen Island, Straits of Magellan.

The type is in the Museum of Comparative Zoology at Harvard University. Cat. No. 6960, M. C. Z.

**Genus DYNAMENELLA Hansen.**

Sixth and seventh thoracic segments without processes. Abdomen composed of two segments, the first of which is not produced back-

<sup>a</sup> *Sphæroma armata* Milne Edwards.



ward in any process. Terminal abdominal segment usually with a notch, which may or may not be connected anteriorly with a transverse foramen. Sexes alike.<sup>a</sup>

Uropods always with exopod at least half as long as endopod.

Exopod of third pleopod unjointed.

Fourth and fifth pleopoda have both branches subsimilar, with deep, transverse folds, fleshy, and without marginal setæ. Exopod of fifth pleopod generally distinctly two-jointed.

Hansen makes *Dynamene perforata* Moore the type of this genus.

**DYNAMENELLA AUSTRALIS, new species.**

Body 4 mm. wide:  $7\frac{1}{2}$  mm. long. Head quadrangular, frontal margin produced in a small median point. The first pair of antennæ extend to the post-lateral angle of the first thoracic segment; the flagellum is composed of ten articles. The second pair of antennæ reach the posterior angle of the fourth thoracic segment; the flagellum is composed of sixteen articles.

The segments of the thorax are similar in shape and size. The epimera are not distinct from the segments. The lateral edges of the segments are almost straight. Two rows of tubercles extend along the posterior margin of the seventh segment, the two middle tubercles of the last row being very broad; the other segments are entirely smooth.

The two segments of the abdomen are thickly granulated. Eight tubercles are placed in a transverse line on the first segment. On the terminal segment there are three rows of four tubercles in each row in transverse series. In some of the specimens the two middle tubercles of the last row are wanting. The abdomen narrows rapidly toward its extremity, which is deeply excavate, the excavation being wider anteriorly than posteriorly. A small tubercle is placed just above the excavation. The uropods extend but a little beyond the extremity of the abdomen. The inner branch is narrow, long, and rounded posteriorly. The outer branch is leaf-shaped, broad, pointed at its extremity, and somewhat longer than the inner branch.

Both branches of the fourth pleopods are similar, fleshy, crossed with transverse folds, and the exopod is unjointed. The exopod of the third pleopod is also unjointed.



FIG. 19.—DYNAMENELLA AUSTRALIS. ABDOMEN AND LAST THORACIC SEGMENT.  $\times 6\frac{1}{2}$ .

<sup>a</sup> Although the forms which I believed to be the females of *Dynamenella perforata* may prove to be young males, those supposed by Doctor Hansen to be the females of this species can not be so considered, inasmuch as adult males are found exactly similar to them. The females of *Dynamenella perforata* probably resemble the males, as do the females of all the species which I have referred to Doctor Hansen's genus.

The body of the specimen is marked with patches of black over a light surface. The abdomen is dark, as well as the head, and there is a broad stripe of the darker color on the inner uropod.

The two sexes are similar in every respect.

This species differs from *Sphæronoma scabricula* Heller<sup>a</sup> in the absence of granules on the segments of the thorax, the absence also of the two carinated ridges on the terminal segment of the abdomen, and the difference in the shape of the uropoda, the inner branch in *Sphæronoma scabricula* being broad and obtuse at the apex, and the outer branch narrow, lanceolate, and longer, while in the present species the inner one is long and narrow, the outer one being broad, but pointed posteriorly.

This species also differs from *Cymodoce cordiforaminalis* Chilton,<sup>b</sup> from New Zealand, in the difference in the arrangement of the tubercles of the abdomen, in the narrower inner branch of the uropoda, and in the absence of the spine in the foramen.

A number of specimens, some imperfect, both males and females, are from Cape Town, Africa.

The types are in the U. S. National Museum, Cat. No. 32248.

Genus DYNAMENISCUS Richardson.<sup>c</sup>

Seventh segment of thorax not produced backward in any processes.

Abdomen composed of two segments, the first of which has indications of partly coalesced segments and is not produced backward in any process. Terminal abdominal segment with a median notch, which has no median lobe or tooth.

Both branches of the fourth pleopoda are similar, with transverse folds, fleshy, and without plumose marginal setæ.

Exopod of the fourth pleopod unjointed.

Exopod of the third pleopod unjointed.

Endopod of second pleopod without stylet in male. Branches of uropods strongly unlike; inner branch short, rudimentary; outer branch, long and curved.

The type of the genus is *Cilicæa carinata* Richardson.

DYNAMENISCUS CARINATUS Richardson.

*Cilicæa carinata* RICHARDSON, Am. Naturalist, XXXIV, 1900, p. 224; Proc. U. S. Nat. Mus., XXIII, 1901, pp. 535-536, figs. 17-19; Bull. U. S. Nat. Mus., No. 54, 1905, pp. 319-320, figs. 350-352.

*Dynameniscus carinatus* RICHARDSON, Bull. U. S. Nat. Mus., No. 54, 1905, pp. x, xi.

<sup>a</sup>Reise der Osterr-Fregatte Novara um die Erde, Zool., Part 2, 1865, 3 Abth., p. 141, pl. XII, fig. II.

<sup>b</sup>Trans. New Zealand Institute, XV, 1882-83, pp. 188-190.

<sup>c</sup>Bull. U. S. Nat. Mus., No. 54, 1905, pp. x, xi.

*Locality*.—Coast of Georgia.

*Depth*.—440 fathoms.

Collection of the U. S. National Museum.

The head has a median projection on the anterior margin, produced forward in the form of a large tubercle. The eyes are colorless. The first pair of antennæ reach the posterior margin of the head; the flagellum is composed of eight articles. The second pair of antennæ

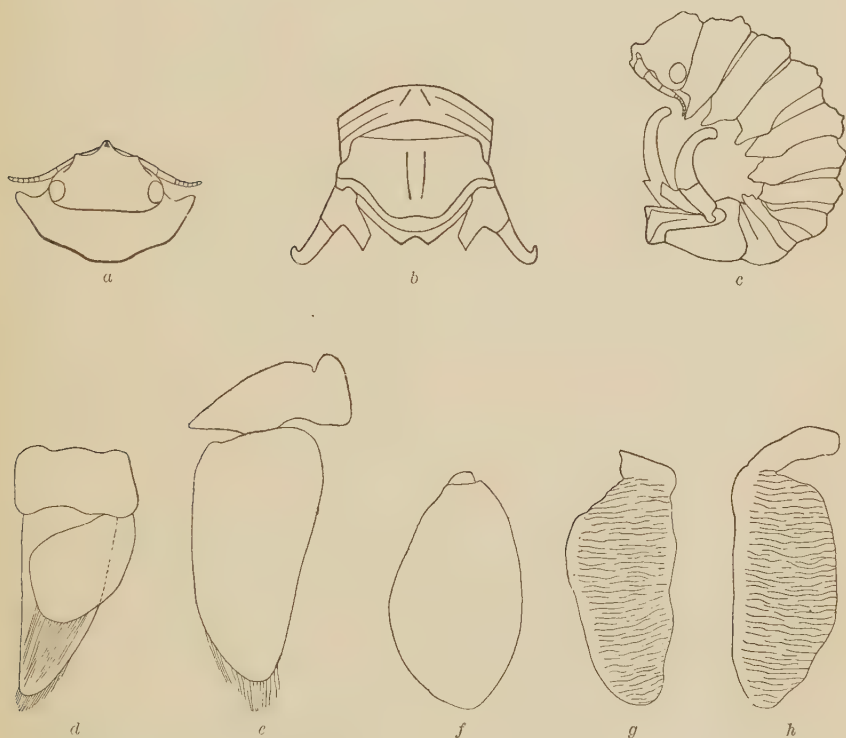


FIG. 20.—*DYNAMENISCUS CARINATUS*. *a*, HEAD. *b*, ABDOMEN. *c*, LATERAL VIEW. *d*, SECOND PLEPOD (RIGHT SIDE).  $\times 27$ . *e*, THIRD PLEPOD OF RIGHT SIDE. (ONE BRANCH.)  $\times 52$ . *f*, THIRD PLEPOD OF RIGHT SIDE. (OTHER BRANCH.)  $\times 52$ . *g*, FOURTH PLEPOD OF RIGHT SIDE. INNER BRANCH.  $\times 39$ . *h*, FOURTH PLEPOD OF RIGHT SIDE. OUTER BRANCH.  $\times 39$ .

reaches the posterior margin of the first thoracic segment. The segments of the thorax are roughly granulated. A transverse median ridge or elevation appears on each one of the segments, giving the dorsum, from a lateral view, a very rugged appearance. The epimera are rough and are drawn out laterally in very acute angles.

The abdomen is composed of two segments, the first segment being formed of several coalesced segments, as indicated by two suture lines. In the center of this segment are two longitudinal ridges, placed obliquely, so as almost to meet anteriorly and to diverge at the

other extremity. This segment projects down over the last segment at either side. The last segment has a deep excavation at its posterior extremity, around and above which is a carinated ridge extending entirely around the whole of the posterior half of the segment. Two small longitudinal ridges are in the center of the segment. The inner branch of the uropoda is very short, not reaching the extremity of the abdomen by some distance; it is quadrangular in shape, with sides nearly parallel, and obliquely truncated at the end. The outer branch of the uropoda is long, curved, and pointed at the end, resembling a hook somewhat.

The color is a light yellow. In appearance the little isopod is very rough and rugged looking.

The only specimen is a male.

#### Genus DISCERCEIS Richardson.<sup>a</sup>

Thorax composed of seven segments, the seventh segment not being produced backward in any processes. Abdomen composed of two segments, the first of which has indications of partly coalesced segments, and is not produced backward in any processes. Terminal abdominal segment with a median notch, which bears a tooth or lobe in the center.

Both branches of the fourth pleopoda are similar, with transverse folds, fleshy, and without plumose, marginal setæ.

Exopod of the fourth pleopod unjointed.

Exopod of the third pleopod jointed, and composed of two segments.

Branches of uropoda unlike, strongly dissimilar; inner branch short, rudimentary; outer branch long and somewhat curved.

The type of the genus is *Cilicæa granulosa* Richardson.

#### DISCERCEIS GRANULOSA Richardson.

*Cilicæa granulosa* RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 841, fig. 18; Ann. Mag. Nat. Hist. (7), IV, 1899, pp. 186-187; Bull. U. S. Nat. Mus.; No. 54, 1905, pp. 309-310, fig. 335.

*Discerceis granulosa* RICHARDSON, Bull. U. S. Nat. Mus., No. 54, 1905, p. x.

*Locality*.—Cerro Island, Lower California.

*Depth*.—20 fathoms.

Collection of the U. S. National Museum.

The surface of the body is densely granulated; the granules are large and close together. Width,  $4\frac{1}{2}$  mm.; length, 9 mm.

The head has the anterior margin thickened and produced in a small median point, on either side of which the margin is lobate. The eyes are situated post-laterally. The first pair of antennæ extend to the posterior margin of the first thoracic segment; the first article of the peduncle is oblong; the second article is short. The second pair of antennæ extend to the posterior margin of the third thoracic segment.

<sup>a</sup> Bull. U. S. Nat. Mus., 1905, No. 54, p. x.



The first thoracic segment is longer than any of the following segments. The epimera are twice as broad as long.

The first abdominal segment is short and has indications of three coalesced segments. There are three transverse elevations on this segment which are densely covered with granules. The terminal segment has three transverse elevations at the base, the median one terminating in a spine. On its posterior margin is a quadrangular excavation with a long median tooth, bearing a spine at its extremity. At the base of the tooth is a small elevation. On either side of the terminal excavation, a short distance up the lateral margin, is a small spine. The fixed inner branch of the uropoda is small and short, the outer branch is long, blunt at the extremity, somewhat incurved, and reaches, when open, much beyond the terminal segment.

The margins of the terminal segment and the edges of the outer branch of the uropoda are pubescent.

The legs are all simple, ambulatory.

There are but two specimens of this species, both of which are males.

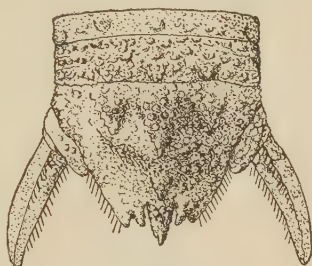


FIG. 21.—DISCERCEIS GRANULOSA.  
LAST THORACIC SEGMENT AND ABDOMEN.  $\times 8$ .

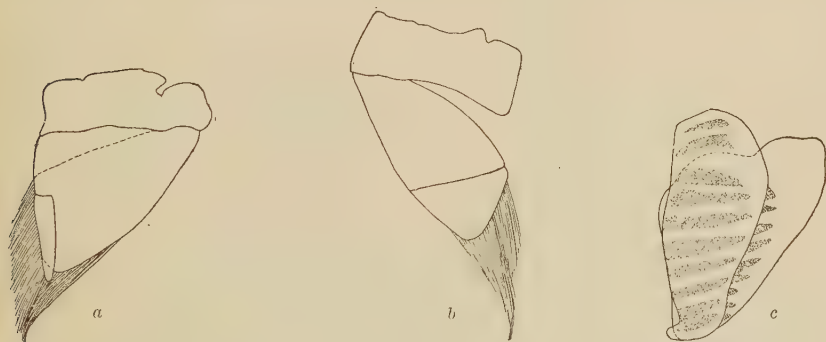


FIG. 22.—DISCERCEIS GRANULOSA. *a*, SECOND PLEPOD OF RIGHT SIDE.  $\times 52$ . *b*, THIRD PLEPOD (EXOPOD).  $\times 52$ . *c*, FOURTH PLEPOD.  $\times 51$ .

#### DISCERCEIS LINGUICAUDA Richardson.

*Cilicæa linguicauda* RICHARDSON, Proc. U. S. Nat. Mus., XXIII, 1901, pp. 536–537, fig. 20; Bull. U. S. Nat. Mus., No. 54, 1905, p. 309, fig. 334.

*Discerceis linguicauda* RICHARDSON, Bull. U. S. Nat. Mus., No. 54, 1905, p. x.

*Locality*.—Cape Catoche, Yucatan.

*Depth*.—24–25 fathoms.

Collection of the U. S. National Museum.

Body  $3\frac{1}{2}$  mm. long: 7 mm. wide.

Head subtriangular in shape; frontal margin with a small median point; eyes post-laterally situated. The first pair of antennæ reach the posterior margin of the first thoracic segment; the second pair touch the fourth segment.



FIG. 23.—DISCERCES LINGUICAUDA. ABDOMEN.

The first segment of the thorax is a little longer than any of the others, which are similar in size. The epimera are not distinct from the segments, and are produced into acute points, with the exception of the last segment, which has the epimera quite rounded.

The abdomen is composed of two segments, the first of which gives indication of three coalesced segments, and has a small tooth on each side on its post-lateral margin. The last segment is swollen anteriorly, and bears three low tubercles on this portion. The extremity of the abdomen is marked by a sinus, which is almost completely filled by a single large tooth, which is posteriorly triangular and extends beyond the lateral teeth formed by the sinus. This central tooth bears a small, pointed tubercle near its base. The branches of the uropoda are strongly unlike; the inner branch is short, rudimentary; the outer branch is slightly incurved and is somewhat longer than



FIG. 25.—DISCERCES LINGUICAUDA. FOURTH PLEPOD.  $\times 52$ .

the abdomen.

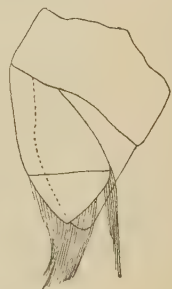


FIG. 24.—DISCERCES LINGUICAUDA. THIRD PLEPOD.  $\times 52$ .

The color is a dull yellow. The lower part of each thoracic segment is densely granulated as well as the whole surface of the abdomen. The edges of the segments and the uropoda are fringed with hairs.

The only specimen is a male.

#### Genus CASSIDIAS, new genus.

Mouth parts of female metamorphosed. Seventh segment of thorax not produced backward in any process.

Abdomen composed of two segments, the first of which is not produced backward in a median process. Terminal abdominal segment, with a narrow notch, which is sometimes concealed dorsally, but a groove is formed beneath by the infolding of the margins.

Both branches of the fourth pair of pleopods are similar, fleshy, with transverse folds and without marginal setæ. The exopod of the third pleopod is two-jointed.

The branches of the uropods are similar, the outer one being capable of folding under the inner one.

This genus is nearest to *Cussidinopsis* Hansen than to any other genus, but differs in having the mouth parts metamorphosed in the female and in having the head of normal size.

The type of the genus is *Cassidias argentina*, the description of which follows.

**CASSIDIAS ARGENTINEA**, new species.

Body oval, contractile into a ball. Head wider than long, with the front marginate and produced in a small median point. The eyes are small, composite, and placed in the post-lateral angles. The first pair of antennæ have the first article oblong, about one and a half times longer than wide; the second article is minute, round; the third article is narrow, elongate, and about twice as long as the second. The flagellum is composed of nine articles and extends to the middle of the

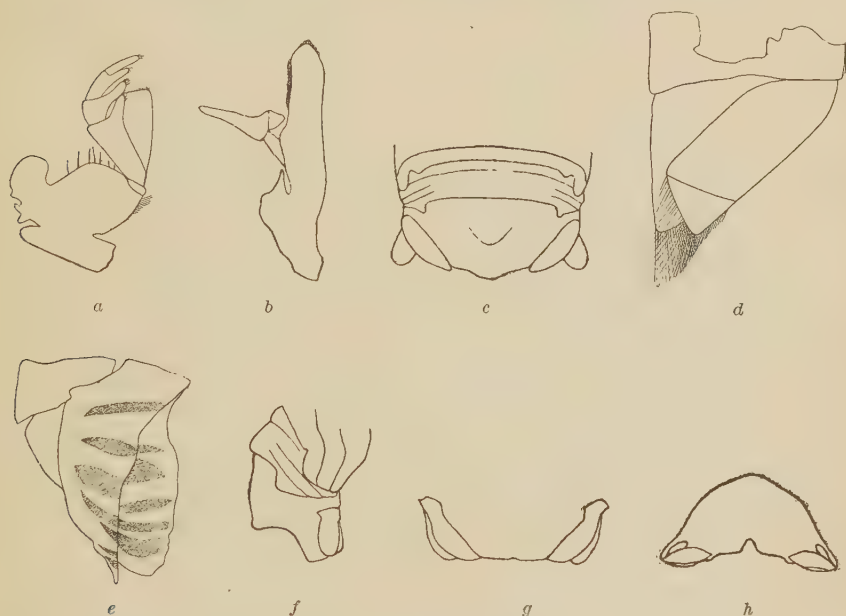


FIG. 26.—*CASSIDIAS ARGENTINEA*. *a*, MAXILLIPED OF FEMALE.  $\times 52$ . *b*, FIRST MAXILLA OF FEMALE.  $\times 52$ . *c*, ABDOMEN AND LAST THORACIC SEGMENT OF FEMALE.  $\times 4\frac{1}{2}$ . *d*, THIRD PLEOPOD.  $\times 39$ . *e*, FOURTH PLEOPOD.  $\times 39$ . *f*, LATERAL VIEW OF ABDOMEN. *g*, ABDOMEN. *h*, TERMINAL VIEW OF ABDOMEN.

first thoracic segment. The second antennæ, with a flagellum of ten articles, extend to the posterior angle of the first thoracic segment.

The first segment of the thorax is a little longer than any of those following. Epimera are not distinct on any of the segments, but they are indicated by faint lines of depression. The lateral parts of the segments are drawn out in narrow processes.

The abdomen is composed of two segments, the first of which has three suture lines on either side, indicating coalesced segments. The terminal segment is produced in a truncate extremity, which has a small rounded excavation in the center. The notch is entirely concealed in a dorsal view, and is formed by the infolding of the sides.

At the base of the segment is a large prominent median elevation or tubercle. The inner immovable branch of the uropoda is long and narrow, leaf-shaped, and pointed at the extremity. The outer branch is a little shorter than the inner branch and has the posterior extremity rounded. The endopod and exopod of the fourth pleopod are similar, rather fleshy, with transverse folds, and without marginal setæ. The

exopod of the third pleopod is two-jointed.

All the legs are ambulatory in structure.

This genus, to which *Cymodoce darwini* Cunningham<sup>a</sup> should be referred, comprises as yet but two species. The present one differs from *Cassidias darwini* in the much



FIG. 27.—*CASSIDIAS DARWINII*. *a*, LATERAL VIEW OF ABDOMEN. *b*, ABDOMEN.

longer exopod of the uropoda, in the much larger median tubercle on the terminal abdominal segment, and in the more shallow notch at the extremity of this segment.

Two specimens, both females, come from off Rio de la Plata, Argentine Republic. They were collected by the U. S. Bureau of Fisheries steamer *Albatross* in 1887, at a depth of  $10\frac{1}{2}$ – $11\frac{1}{2}$  fathoms, among sand and broken shells.

The type is in the U. S. National Museum, Cat. No. 32249.

<sup>a</sup>Trans. Linn. Soc. London, XXVII, 1871, pl. LIX, figs. 1a, b; Studer, Abhandlungen d. Koniglichen Akademie d. Wissenschaften zu Berlin, 1883, pp. 18–19, figs. 6a, b; Dollfus, Mission Scientifique du Cap Horn, 1891, pp. 65–66, pl. VIII, figs. 8a, b.



# SCHIZOPOD CRUSTACEANS IN THE U. S. NATIONAL MUSEUM. THE FAMILIES LOPHOGASTRIDÆ AND EUCOPIIDÆ.

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## INTRODUCTION.

The paper submitted herewith forms the first installment of a series of articles describing the Schizopod collections in the United States National Museum. It treats of the families Lophogastridæ and Eucopiidæ, which consist almost exclusively of deep-sea forms. The material at hand, chiefly in the genus *Gnathophausia*, is so rich that it has been possible to prepare a complete revision of that genus, and it has been found that some characters, which were regarded hitherto as of specific value, are but differences of age in the same species. This made it necessary to prove the changes of these characters with age, and consequently, the discussion of some of the species is somewhat lengthy.

Other families of the Schizopods will be taken up successively, and the results will be published similarly, as the time at the disposal of the writer will permit.

## Family LOPHOGASTRIDÆ G. O. Sars.

### 1. LOPHOGASTER TYPICUS M. Sars.

ORTMANN, Bull. U. S. Fish Comm. for 1903, Pt. 3, 1905, p. 967 (see for complete list of literature).—STEBBING, South African Crustacea, Pt. 2, Cape of Good Hope Dept. Agric. 1902, p. 43.—HOLT and TATTERSALL, Rep. Fisher. Ireland, Pt. 2, Append., IV, 1905, p. 141.

Of this species, material was available from two regions, from which it was not hitherto known, namely, the western Atlantic (coast of United States and Gulf of Mexico), and the western Pacific (Japan).

The specimens from the western Atlantic are divided into three sets: One from the coast of the Carolinas (*Albatross* stations Nos. 2314, 2601, 2602), consisting of together 10 males and 3 females; the second from the Gulf of Mexico (Stations Nos. 2399, 2401, 2403),

together 9 males and 1 female; the third from Key West (*Fish Hawk* stations Nos. 7282, 7283, 7286).

The northern specimens, from the Carolinas, compare with the European (and South African) form in the following particulars:

(1) The rostrum is longer, generally about as long as the peduncle of the antennula, but in two specimens (males) it is shorter than this peduncle, although longer than in the typical form; and in 2 females from Station No. 2602 it is slightly longer than this peduncle but distinctly shorter than the antennal scale.

(2) The antennal scale has on the outer margin a greater number of teeth; the normal number seems to be 6 or 7; five specimens have 6 teeth on both sides; two specimens have 6 on one side, and 7 on the other; one female has 7 teeth on both sides. Besides, there is one specimen with 6 teeth on one side, and three with 7 teeth on one side, while the other side could not be determined owing to its damaged condition. Finally, one female has 6 teeth on the right, and 5 on the left side. Thus 5 to 7 are the numbers found, 5 once, 6 fourteen times, 7 seven times.

(3) In the number of lateral teeth of the telson, these specimens agree well with the European form, the usual number being 3 on each side. There are, however, a few exceptions. Four specimens have 3 teeth on one side, but only 2 on the other; one specimen has 3 teeth on one side and 4 on the other (female, Station No. 2602), and one (male, Station No. 2601), has 1 spine only on each side, placed at a different level, the right one being more proximal than the left one.

Those from the Mexican Gulf have the following characters:

(1) The rostrum is in one case only shorter than the peduncle of the antennula; in seven specimens it is longer than this peduncle, but shorter than the antennal scale; and in one case (Station No. 2399) it is about as long as the antennal scale (in the remaining individual it is damaged). Thus the average slightly exceeds that of the northern set.

(2) The antennal scale has in seven cases 6 teeth on both sides; in one case there are 6 on one, 7 on the other side; and in two cases there are 7 teeth on both sides. This agrees well with the condition found in the northern set.

(3) The telson has uniformly 3 teeth on both sides, with one exception, where there are 2 on the right and 3 on the left. This seems to be the normal condition in Atlantic specimens.

The specimens from Key West (6 males, 2 females), collected by the U. S. Bureau of Fisheries vessel *Fish Hawk*, agree very well with the Gulf form. The rostrum is as long as the peduncle of the antennula, except in two cases, in which it is slightly longer. The antennal scale has generally 6 teeth, but in two specimens there are 7 on the right side. The telson has 3 teeth on each side, but in two specimens there are 2 teeth on one side and 3 on the other.

The largest West Atlantic specimen is a male from Station No. 2401, measuring 29 mm. The few females at hand are all small and measure between 16 and 18 mm.

A series of fifteen specimens, 9 males and 6 females, from six stations off Honshu Island, Japan, was examined. None of them were found to be smaller than 21 mm.; the females were between 21 and 27 mm., and two of them (24 and 27 mm.) were gravid; the males being between 22 and 32 mm. They have the following characters:

(1) The rostrum is comparatively long, even longer than in the West Atlantic form, which in turn exceeds the average found in the Hawaiian. There is not a single individual in which it is shorter than the peduncle of the antennula. In three (2 males and 1 female) it is about as long as this peduncle, while in all others it is distinctly longer. Generally it is shorter than the scale of the antenna, but in a few cases it is of equal length.

(2) The antennal scale has generally only 3 teeth on the outer margin; in one individual (male, 31 mm.) there are 2 on the right and 3 on the left side, and in another one (male, 27 mm.) the reverse is the case. Thus these specimens represent the opposite extreme of that seen in the West Atlantic form. The Hawaiian form is intermediate with 3 to 5 teeth.

(3) The telson generally has 2 spines on the lateral margins on each side. Four specimens, however, constitute an exception, having 1 spine on the right side and 2 on the left.

The above records show that these characters can not be regarded as of specific value. Taking the European and South African form as the type, the West Atlantic specimens agree with them in the spines of the telson, while all the Pacific specimens possess the tendency to reduce their number. The rostrum is shortest in the typical form, but in all others shows a tendency to become longer; the Hawaiian form comes close to the typical in this respect, while both the West Atlantic and the Japanese differ more distinctly. In the number of teeth of the antennal scale the typical form is intermediate (5); the West Atlantic form varies in one direction (6 to 7), while the Pacific varies in the other: the Hawaiian with 3 to 5 teeth is more closely allied to the typical form than the Japanese, which has only 2 or 3 teeth.

It is very likely that intermediate localities, when found, will tend to connect these forms more closely, and it would be interesting to know particulars about these connecting links.

*Localities represented in the U. S. National Museum.*FROM U. S. BUREAU OF FISHERIES STEAMER *Albatross* STATIONS.

- 2314.—4 males. Between Charleston and Savannah, off South Carolina coast; 159 fathoms.  
2399.—1 male. Gulf of Mexico; 196 fathoms.  
2401.—1 male. Gulf of Mexico; 142 fathoms.  
2403.—7 males, 1 female. Gulf of Mexico; 88 fathoms.  
2601.—5 males. Between Cape Hatteras and -Charleston, off North Carolina coast; 107 fathoms.  
2602.—1 male, 2 females. Between Cape Hatteras and Charleston, off North Carolina coast; 124 fathoms.  
3707.—1 female. Off Honshu Island, Japan; 63 to 75 fathoms.  
3714.—1 male, 1 female. Off Honshu Island, Japan; 48 to 60 fathoms.  
3715.—4 males, 1 female. Off Honshu Island, Japan; 68 to 65 fathoms.  
3717.—1 male. Off Honshu Island, Japan; 100 to 63 fathoms.  
3718.—3 males, 2 females. Off Honshu Island, Japan; 65 fathoms.  
3740.—1 female. Off Honshu Island, Japan; 65 fathoms.

FROM U. S. BUREAU OF FISHERIES STEAMER *Fish Hawk* STATIONS.

- 7232.—4 males, 2 females. Gulf Stream, off Key West; 109 fathoms.  
7283.—1 male. Gulf Stream, off Key West; 127 fathoms.  
7286.—1 male. Gulf Stream, off Key West; 133 fathoms.

*Localities previously recorded.*—Norway, Shetland Islands, Ireland, Bay of Biscay, Mediterranean, Cape of Good Hope, 20–300 fathoms; off Cape St. Blaize, South Africa, 40 fathoms; Hawaiian Islands (Pailolo Channel, Molokai and Laysan Islands), at about the same depth.

2. *LOPHOGASTER SPINOSUS*, new species.

Plate I, figs. 1a, 1b.

*Type.*—Cat. No. 11464, U.S.N.M. Female. U. S. Bureau of Fisheries steamer *Albatross* station No. 2666, between Bahamas and Cape Fear, North Carolina. Latitude  $30^{\circ} 47' 30''$  north; longitude  $79^{\circ} 49'$  west; depth, 270 fathoms.

Although built in the main according to the pattern of the typical and hitherto only known species of the genus, this species differs from the latter in several well-marked characters.

(1) Rostrum greatly elongated, almost as long as the carapace in the median line. It exceeds the antennal scales, which also are greatly elongated, and it is without teeth or denticulations. It is directed forward, and is almost straight.

(2) Antennal scale greatly elongated and lanceolate; its outer margin is formed by a strong rib, which extends into a long spine; the inner, lamellar part is much shorter, and reaches only to about the distal third of the spine. Outer margin of the spine with 9 spiniform ser-



rations on right side, and with 10 on the left; and, further, there is a similar serration on the inner margin, just above the upper end of the lamellar part, and opposite to the second tooth (counted from the tip) of the outer margin.

(3) Lateral wings of carapace produced posteriorly into a long spine on each side, which is almost one-third as long as the carapace (excluding rostrum).

(4) Sixth abdominal segment with a subdorsal spine directed straight backward on posterior margin, at the base of the telson, on each side.

(5) Telson slightly more elongated than in *L. typicus*, and with five marginal spines on each side. The terminal spines are similar to those of *L. typicus*: two pairs, and between them at the posterior termination a serrated crest, which, however, has only four teeth. (The tip of the telson is not very well preserved in the type, as the two outer, smaller terminal spines are broken off.)

*Measurements*.—Total length: 39 mm.; length of rostrum (in front of eyes): 8; length of carapace along dorsal line, including rostrum: 19.

#### GENUS GNATHOPHAUSIA Willemoes-Suhm.

##### KEY TO THE SPECIES OF GNATHOPHAUSIA:

- a*. Antennal scale small, not jointed, no strong rib terminating in a spine on outer margin; outer margin serrate. Epimera of sixth abdominal segment united ventrally, forming together a cordiform, concave plate, incised at apex. Dorsal keel of carapace interrupted. Lower lateral keel not curving upward behind, but terminating in a spine at the postero-inferior angle. Branchiostegal lobe generally with a well-developed spine (sometimes obsolete). Maxillipeds with a small exopodite.
- b*. Both lappets of the epimera of the second to fifth abdominal segment pointed and spiniform. Antennal scale subovate, apex shortly pointed.
- c*. Rostrum and all spines of carapace comparatively short or obsolete....*ingens*
- c'*. Rostrum and spines of carapace well developed and comparatively long.....*calcarata* (*a*)
- b'*. Anterior lappet of the epimera of the first to the fifth abdominal segment small, rounded; posterior lappet pointed and spiniform. Antennal scale sub lanceolate, tapering to a sharp, spiniform point...*gigas* (+*drepanephora*?)
- a'*. Antennal scale large, of usual form, jointed at the extremity, outer margin formed by a strong rib terminating in a spine. Epimera of sixth abdominal segment not confluent ventrally.
- b*. Lower lateral keel of carapace not curving up behind, but terminating in a spine on the postero-inferior angle of the carapace. Median keel of carapace interrupted, with spiniform serrations. Median line of abdominal segments with strong spines. Upper lateral keel of carapace wanting. Two epimeral spines on each side of the anterior section of sixth abdominal segment. Maxillipeds with exopodite.....*gracilis*
- b'*. Lower lateral keel of carapace curving up behind; no spine at postero-inferior angle of carapace. Median keel of carapace not interrupted, without spiniform serrations. Median line of abdominal segments—if armed at all—only with posteriorly projecting, small spines. Upper lateral keel of carapace present, very rarely wanting. Maxillipeds without exopodite.

*a* *G. calcarata* may be the young stage of *G. ingens*.

- c. Two epimeral spines on each side of anterior section of sixth abdominal segment. Upper lateral keel of carapace present. Antennal spine obsolete. Branchiostegal lobe with a well-marked, triangular spine. Spine of outer margin of antennal scale projecting considerably beyond terminal lobe, serrated on both margins ..... *longispina*
- c'. One epimeral spine on each side of anterior section of sixth abdominal segment. Antennal spine more or less distinct. Branchiostegal lobe without spine, generally rounded, rarely angular. Spine of outer margin of antennal scale not, or only slightly, projecting beyond terminal lobe.
- d. Upper lateral keel of carapace present.
- e. Abdominal segments dorsally slightly keeled, with small, posteriorly projecting spines. Epimera of five anterior abdominal segments pointed posteriorly. Branchiostegal lobe rounded.
- f. Carapace not suddenly constricted anteriorly, and forming no shoulder. Branchiostegal lobes moderately developed ..... *zöëa*
- f'. Carapace suddenly constricted anteriorly, forming a distinct shoulder in front of the anterior ends of the upper lateral keels. Branchiostegal lobe greatly expanded ..... *scapularis*
- e'. Abdominal segments dorsally not keeled, without spines. Epimera of five anterior abdominal segments rounded posteriorly. Branchiostegal lobe slightly angular ..... *affinis*
- d'. Upper lateral keel of carapace wanting. Branchiostegal lobe rounded or angular, but without spine. Abdominal segments dorsally without keel, but posteriorly with a small, depressed, triangular projection. Epimera of five anterior abdominal segments ending in small points posteriorly ..... *elegans*

### 3. GNATHOPHAUSIA INGENS (Dohrn).

*Lophogaster ingens* DOHRN, Zeitschr. wiss. Zool., XX, 1870, p. 610, pl. xxxi, figs. 12-14.

*Gnathophausia ingens* G. O. SARS, Forh. Selsk. Christiania, 1883, No. 3; Rep. Challenger, XIII, 1885, p. 30, pl. II.

I have never seen this species. It is founded upon a very old female, sexually mature, and a similar female has served as the basis for Sars's description. It is very closely allied to *G. calcarata*, and I strongly incline to the opinion that it will prove to be *G. calcarata*, representing an old female of that species, in which case it will be called *G. ingens*, the name *calcarata* becoming a synonym.

*G. ingens* especially agrees with *G. calcarata* in the following important characters:

(1) General form of body, and arrangement of keels and spines of carapace.

(2) Sculpture and armature of abdomen, especially as the epimera of the five anterior segments are identical in both forms.

(3) Shape of antennal scale.

It differs from *G. calcarata* in the following respects:

(1) In the shorter rostrum and the inferior development of all spines of the carapace, the supraorbital spine being even wanting, the branchiostegal spine being obsolete.

(2) In the absence of the two pairs of oblique keels on the superior face of the carapace.

(3) In the shape of the ventral epimeral plate of the sixth abdominal segment, which, although closely approaching the shape seen in the largest specimens of *G. calcarata*, has the tips separated and bifid, the inner spine being slightly longer.

The first of these characters can not be regarded as of specific value. Dohrn's specimen measured 155 mm., Sars's specimen 157 mm. The largest *G. calcarata* at hand (and ever observed) measures 115 mm., and consequently, is considerably younger than the known specimens of *G. ingens*. Now, as shown below, it is a general rule in this genus that all the spines of the carapace and the rostrum decrease in relative size with advancing age, and thus it is easy to believe that the slight development of these spines in *G. ingens* is due to old age only. In fact, if we imagine that *G. calcarata* grows larger and that the spines decrease proportionally, we would obtain, at about the size of 150 to 160 mm., the conditions found in *G. ingens*.

As to the second differential character, the lack of the two oblique keels on the upper face of the carapace, this may have been overlooked by Dohrn and Sars. In fact, these two keels were overlooked by Sars in *G. calcarata*; at any rate, they are not mentioned in the description, although one of the figures (Plate IV, fig. 2) shows traces of them.

The third character offers only a slight difference from the condition seen in large specimens of *G. calcarata*. In the latter the tips of the epimeral plate of the sixth abdominal segment are in contact in the median line, while in *G. ingens* they are separated, according to Sars's fig. 6 on Plate II. Moreover, in *G. calcarata* the outer spine of the bifid end of each of the tips is greatly longer than the inner, while in *G. ingens* the inner spine is slightly the longer.

At present this last character remains the only one upon which *G. ingens* and *G. calcarata* can be separated, and it is not improbable that further material will demonstrate that one form passes into the other when we consider the changes in the sixth epimeral plate in its development from the young *G. calcarata* to the old.

*Distribution of G. ingens.*—Off the west coast of Africa: "Laos," depth not recorded (Dohrn). Near Aru Island, Arafura Sea (New Guinea), 800 fathoms (Sars).

## 4. GNATHOPHAUSIA CALCARATA G. O. Sars.

Plate I, figs. 2a, 2b.

*Gnathophausia calcarata* G. O. Sars, Forh. Selsk. Christiania, 1883, No. 5; Rep. Challenger, XIII, 1885, p. 35, pl. IV.—ORTMANN, Bull. U. S. Fish Comm. for 1903, Pt. 3, 1905, p. 968.

*Gnathophausia bengalensis* WOOD-MASON, Ann. Nat. Hist. (6), VIII, 1891, p. 269.

*Specific characters.*—Aside from the group characters (see *a* in the key), the following are to be considered as of specific value:

- (1) The subovate, not lanceolate, shape of the antennal scale.
- (2) The presence of two pairs of oblique keels on the upper surface of the carapace.
- (3) The shape of the epimera of the second to fifth abdominal segment, both lappets of which are pointed and spiniform.
- (4) The bifid points of the epimera of the sixth abdominal segment, with the inner point much shorter than the outer (in old specimens only).

*Description.*—Carapace with dorsal, upper, and lower lateral keels. Dorsal keel interrupted in the middle part. Lower lateral keel ending in a spine at the postero-inferior angle of the carapace. On upper face of carapace, between median and upper lateral keels, there are two oblique keels on each side, converging posteriorly, the anterior pair running toward the anterior end of the posterior section of the dorsal keel, but not joining it; the posterior pair running almost parallel to the first pair, their hind ends not joining the dorsal keel. Rostrum of various lengths, according to age, about as long as the rest of the carapace in very young specimens. In older ones, the part in front of the supraocular spines is about one-third of the length of the rest of the carapace. Supraocular spines very small, sometimes obsolete. Antennal spines small, but well developed, the most constant spines in size. Branchiostegal spines quite large and well developed in young specimens, and longer than the antennal spines. In old specimens they are not only relatively, but absolutely smaller, and become shorter than the antennal spines. Postero-dorsal spine of various lengths, according to age, but the variation is not very great; it is always well developed, but shorter than the postero-inferior spines. Spines of postero-inferior angle greatly varying in length with age; very long, almost half the length of the carapace (excluding the rostrum) in young specimens, and distinctly diverging and spreading out in a postero-lateral direction. In old specimens they are much shorter, even absolutely shorter, and are as short as about one-seventh of the carapace (without rostrum); they are not divergent, but directed straight backward. Branchiostegal, postero dorsal, and postero-inferior spines, when well developed, with more or less distinct serrations, which become indistinct with age, and even disappear entirely.



Antennal scale small, subovate, pointed; point not produced. Outer margin serrate, serrations three to six (sometimes different on right and left sides), the distal serration at a certain distance from the tip of the scale, and the margin between this serration and the tip either straight or slightly emarginate, thus giving a more or less truncate appearance to the scale.

Abdomen sculptured by a distinct transverse groove near the posterior margin of each of the five anterior segments; there is a similar but fainter groove near the anterior margin. The posterior groove is continued down to the epimeral lappets, and here its anterior edge is marked on an elevated ridge. This sculpture is seen clearly only in well-preserved specimens, and sometimes there are traces of a subdorsal longitudinal keel on each side. Also a blunt median keel is sometimes indicated. The epimera of the second to the fifth segment consist of two lappets, which are both produced and acutely pointed, the posterior being somewhat longer than the anterior. The anterior lappet of the first segment is considerably shorter than the spiniform posterior lappet, and is not produced into a spine, but bluntly pointed or even obtuse. The epimera of the sixth abdominal segment unite ventrally to form a concave, cordiform plate, which, in old individuals, is produced beyond the posterior margin of the sixth segment. In young individuals the right and left lappets are short and simply pointed, and separated from one another by a shallow emargination. With increasing age they become much elongated, are separated by a narrow slit, and the tips become bifid, a second point developing on the inner side, which is always much shorter than the outer point. In old individuals the inner tips are in contact in the median line and may even overlap.

*Variations with age.*—I had an excellent opportunity to study this species, as over 40 individuals in good condition were available, of very different sizes and ages, ranging from 42 mm. to about 115 mm. The three first-named specific characters are always present, but the fourth is observed only in older individuals. The spines of the carapace are very variable in their development according to age, and generally they are comparatively longer in young specimens and shorter in old ones. Sometimes, in the cases of the branchiostegal and postero-inferior spines, even the absolute length in older specimens is inferior to that in younger ones. This seems to be a general rule in this genus, for it was discovered by the writer in another species of the genus, *G. longispina*.<sup>a</sup>

Another important variation, due to age, is found in the ventral epimeral plate (see Plate I, figs. 2*a*–2*f*). The smallest individual (42 mm., Station No. 3627, fig. 2*a*) has this plate very short; the two tips

<sup>a</sup>Bull. U. S. Fish Comm. for 1903, 1905, p. 970.

are simply pointed and widely separated by a shallow and wide incision. With advancing age the tips of this plate are more produced (specimen of 55 mm., Station No. 2980, fig. 2*b*, and specimen of 68 mm., Station No. 2929, fig. 2*c*), a slight angulation appears on the inner side of the tips, which are not so widely separated, the incision becoming narrower and longer. Farther on the tips are gradually produced beyond the posterior margin of the segment (specimen of 81 mm., Station No. 2919, fig. 2*d*, and specimen of 91 mm., Station No. 4389, fig. 2*e*), the inner angle develops into a distinct spine, which is shorter than the tip, and the two tips approach each other closely, finally coming in contact at the level of the smaller inner point. The incision becomes long and narrow, slit-like. In the largest specimen at hand (115 mm., Station No. 3670, fig. 2*f*) the two tips approach so closely to each other that the inner point of the left side overlaps that of the right.

*Identity of G. bengalensis with G. calcarata.*—Wood-Mason gives the following differential characters for his *G. bengalensis*:

(1) "Carapace covers the whole of the first and part of the second abdominal somite," while in *G. calcarata* the carapace does not cover the trunk entirely.

(2) "The antennal, branchiostegal, and postero-inferior spines appear quite smooth to the naked eye, being only obsoletely or microscopically serrated."

(3) "The supraorbital spine is readily distinguishable by its shape from the rostral denticles."

(4) "The upper lateral keels are strongly roof-shaped."

(5) "The oblique subdorsal keels are more pronounced."

(6) "Antennal scale more broadly emarginate at the apex."

(7) "The pleural lappets of the last abdominal somite are terminated by two very unequal spines (of which the outer is longer and sharp, and the inner short and blunt), and are separated from one another posteriorly in the mid-ventral line by a long and narrow incision."

Length of Wood-Mason's specimen (female with a rudimentary brood-pouch): 91 mm.

Of these characters, the following may be remarked:

(1) It depends entirely on the state of preservation how much of the trunk or the abdomen is covered by the carapace. In my specimens, there are the following limits: The minimum, when only the trunk is covered, the maximum, when the whole of the first and the anterior part of the second abdominal segment is covered. The latter case corresponds to Wood-Mason's species, but, as it happens, this one is found in a small individual (55 mm. Station No. 2384), which is, in all other respects, and especially in the ventral epimeral plate, a typical *calcarata*. In many of my specimens, in which the state of preservation permits, they being rather flabby, I am able at will to change the degree of covering of the abdomen, by simply pulling out or pushing in the latter.

(2) The serrations are to my eyes, which are normal-sighted, always invisible, and I have to use a lens to discover them. Some-

times, chiefly in old individuals, they are actually wanting. Their presence or absence cannot constitute a specific character.

(3) The supraorbital spine is sometimes distinctly visible, sometimes entirely obsolete. If present, it is always marked by its position. Even when developed, it is so small that its presence or absence cannot be of specific value.

(4) What Wood-Mason means by "roof-shaped" upper lateral keels, I cannot imagine.

(5) The oblique dorsal keels are also found in Sars's species; they are slightly indicated in his fig. 2 (chiefly the posterior pair, which is most important). In poorly preserved, flabby specimens, which have undergone much rough handling, they are sometimes indistinct. They are present in all my individuals, and hence this character can not be accepted as constituting a difference between *bengalensis* and *calcarata*.

(6) The degree of emargination or truncation of the antennal scale offers variations, as is already indicated in Sars's figures (Plate IV, figs. 2, 4, 5). I have called attention to this fact in connection with the Hawaiian material<sup>a</sup>, which is further confirmed by the present material. A real emargination (*i. e.*, a concave marginal line) is comparatively rare; generally there is a truncation, with the marginal line between tip and first tooth straight.

(7) The description of the epimeral plate given by Wood-Mason corresponds exactly to what we see in my figs. 2*a* to 2*f*, with the exception that the inner tip of each epimeral lappet is sharp, not blunt. In younger specimens, however, it *is* blunt (see my figs. 2*b* and 2*c*). Thus this character agrees well with the assumption that *G. bengalensis* is an older and larger *G. calcarata*.

Thus of the seven characters given by Wood-Mason for *G. bengalensis*, six are not actual differences, and one, the fourth, is unintelligible. The only real difference from Sars's description and figure is found in the epimeral plate of the sixth abdominal segment; but this organ, as shown, changes its form with age, and *G. bengalensis* is a rather large individual (91 mm.). Specimens from my material of the same size present an epimeral plate (see fig. 2*c*) closely corresponding to Wood-Mason's description.

Sars had two specimens of this species; the large one was 98 mm., and to it belong the figures of the whole animal (slightly enlarged, Plate IV, figs. 1, 2). The carapace of the smaller one (68 mm.) is figured in his fig. 3. Sars does not say from which individual the other figures are taken, but it seems from the latter. Then his figure of the epimeral plate (fig. 6) belongs to this smaller individual. The same plate of an individual of the same size (68 mm.) is figured in my

<sup>a</sup> Bull. U. S. Fish Comm. for 1903, 1905, p. 969.

fig. 2c, and shows a rather more advanced stage, although it comes very close to Sars's figure, and differs considerably from the epimeral plate of larger specimens. Sars's figure is about intermediate between my figures 2b and 2c, representing specimens of 55 and 68 mm., respectively.

*Sex in G. calcarata.*—It is rather hard to distinguish male and female in this genus unless full-grown individuals are at hand. Old females are readily recognized by the presence of marsupial lamellæ at the bases of the thoracic legs. These lamellæ "are absent in the male, but the male has, at the coxa of the last pair of legs, posteriorly and on each side, a small tuberculiform prominence, representing the outer sexual appendage."<sup>a</sup>

In young and not quite adult females, however, the marsupial lamellæ are comparatively small. In all the females of the present species, even the largest, the lamellæ were not fully developed, being short and narrow, not folding over one another in the median line, so that a "marsupial pouch" is not formed. In younger individuals these lamellæ are very small, hardly distinguishable. The smallest in which I found traces of them was 64 mm. long (Station No. 2980). In all smaller specimens there was no trace of them, and I was unable to make out whether they were young males or young females, as the male tubercle is generally not visible; in one individual only (55 mm., Station No. 2980) I thought I could see this tubercle. Upward of the size of about 65 mm. it is possible to tell the males from the females, and it is remarkable that in the material examined females were more abundant, there being only 9 males, as against 23 females. It is remarkable, further, that the largest male was only 76 mm. long, and that all specimens above this size were females (17 of them). Sars's largest specimen of 98 mm. is said to be a male, while Wood-Mason's specimen (91 mm.) was a female.

The fact that even the largest females did not have the marsupial pouch completely developed indicates that they were not fully mature sexually. This makes it probable that they would have to develop further before being able to propagate, and suggests the possibility that they may attain the size of *G. ingens*, in which case they might assume the characters of the latter, thus making *G. ingens* the full-grown female of this species.

Most of the specimens were from the Eastern Pacific (California region), only one young one (55 mm., Station No. 2384) being from the Gulf of Mexico. This is distinguished by a very long rostrum and very long postero-inferior spines. The rostrum, in front of the supra-ocular spines, is slightly longer than the rest of the carapace (excluding the postero-dorsal spine), and was even longer than that, since the

<sup>a</sup>Sars, p. 27, and Plate III, figs. 14 and 15.



tip is damaged. The postero-inferior spines are as long as the distance from their base to the posterior base of the branchiostegal lobe (resembling closely Sars's fig. 3 on Plate IV). (A specimen from Station No. 2980, also 55 mm. long, has the rostrum slightly shorter than the carapace, and the postero-inferior spines are only half as long as in the specimen from the Mexican Gulf.) For the rest, this specimen shows no differences; especially the epimeral plate agrees exactly with the specimen from Station No. 2980, shown in my fig. 2*b*. The carapace covers the anterior part of the second abdominal segment, representing the maximum among my material, but this is probably due to the method of preservation. It has the appearance of having been put into strong alcohol at first, and consequently is much contracted. In slightly younger specimens from California the rostrum is relatively of the same length, and the postero-inferior spines at least approach the condition found in the Gulf specimen.

*Localities represented in the U. S. National Museum.*

FROM U. S. BUREAU OF FISHERIES STEAMER *Albatross* STATIONS.

- 2384.—1 young. Gulf of Mexico; 940 fathoms.  
2839.—1 male, 1 female. Santa Barbara Islands, California; 414 fathoms.  
2919.—1 female. Off southern California; 984 fathoms.  
2923.—1 female. Off southern California; 822 fathoms.  
2929.—1 male. Off southern California; 623 fathoms.  
2936.—1 male, 3 females. Off southern California; 359 fathoms.  
2980.—2 males, 1 female. Off southern California; 603 fathoms.  
2986.—1 young. Off Lower California; 684 fathoms.  
3127.—2 females. Off central California; 62 fathoms.  
3348.—1 young. Off northern California; 455 fathoms.  
3627.—1 young. West of Cortez and Tanner Banks; 776 fathoms.  
3670.—1 female. Monterey Bay; 581 fathoms.  
4333.—2 females. Off San Diego; 301 to 487 fathoms.  
4334.—1 male, 1 female. Off San Diego; 514 to 541 fathoms.  
4335.—1 male. Off San Diego; 500 to 530 fathoms.  
4336.—1 male, 1 female. Off San Diego; 518 to 565 fathoms.  
4337.—2 males, 1 female. Off San Diego; 617 to 680 fathoms.  
4339.—1 female. Off San Diego; 241 to 369 fathoms.  
4351.—1 male (?) young, 1 female. Off San Diego; 423 to 488 fathoms.  
4353.—1 female. Off San Diego; 628 to 640 fathoms.  
4354.—2 young. Off San Diego; 646 to 650 fathoms.  
4379.—1 female. Off San Diego; 257 to 408 fathoms.  
4380.—1 female. Off San Diego; 530 to 618 fathoms.  
4381.—1 female. Off San Diego; 618 to 667 fathoms.  
4382.—1 female, 1 young. Off San Diego; 642 to 666 fathoms.  
4389.—1 male, 3 females. Off San Diego; 608 to 671 fathoms.

4390.—1 female. Off Santa Catalina Islands, 1,350 to 2,182 fathoms.  
4528.—1 male. Monterey Bay; 545 to 800 fathoms.

*Previous records.*—Arafura Sea, 800 fathoms (Sars); vicinity of Talaar Island, S. of Mindanao, Philippines, 500 fathoms (Sars); Hawaiian Islands: Kaiwi Channel, and vicinity of Kauai Island, 442–881 fathoms (Ortmann); Bay of Bengal, 1748 fathoms (Wood-Mason).

##### 5. GNATHOPHAUSIA GIGAS Willemoes-Suhm.

Plate II, figs. 1b, 1a.

*Gnathophausia gigas* WILLEMOES-SUHM, Trans. Linn. Soc. London, Zool. (2), I, 1875, p. 28, pl. ix, figs. 16, 17; pl. x, figs. 2, 3.—G. O. SARS, Forh. Selsk. Christiania, 1883, no. 4; Rep. Challenger, XIII, 1885, p. 33, pl. III.—ORTMANN, Bull. U. S. Fish Comm. for 1903, Pt. 3, 1905, p. 968.

This species is closely allied to *G. calcarata*, but differs in certain constant characters. On account of the general resemblance of both species, it is hardly necessary to give a complete description of *G. gigas*, and it will suffice to mention the differential characters.

1. The arrangement of the keels of the carapace is essentially the same in both species, with the exception that the posterior oblique keels of the upper face are entirely wanting in *G. gigas*. The anterior oblique keels are present, occupying the same position as in *G. calcarata*.

2. The spines of the carapace, in young specimens, are about the same as in *G. calcarata*, but the supraocular spine is more distinct, and as large as, or even larger than, the antennal spine. In older individuals all the spines are shorter than in *G. calcarata*, with the exception of the supraocular, which is always distinct. Antennal spine small, branchiostegal generally slightly larger than the latter, postero-dorsal very short. The largest are the postero-inferior spines, which approach closely those of *G. calcarata*, although they are shorter in the average.

3. Antennal scale of *G. gigas* of slightly different shape; it is rather lanceolate, and not ovate, and the terminal point is longer and more tapering. The outer margin has four or five spiniform serrations, the anterior sharp and strong, the posterior small and sometimes obsolete; these serrations, generally, are stronger than in *G. calcarata*.

4. The epimera of the five anterior abdominal segments are different in both species. While in *G. calcarata* both lappets of the second to fifth are strongly developed and are both spiniform, in *G. gigas* only the posterior lappet is produced and spiniform in all five segments, and the anterior is small and rounded (see Sars's fig. 1 on Plate III).

5. The ventral epimeral plate of the sixth abdominal segment differs in both species in the larger individuals. In young specimens of *G.*

*gigas* (see Plate II, fig. 1a, taken from a small individual, 56 mm. long, Station No. 3329), it is rather indifferent in shape, the two tips being widely separated by a very shallow incision; *the two halves are not completely united in the median line.* In larger individuals (see my fig. 1b on Plate II, taken from an immature female about 90 mm. long, Station No. 2741) the tips are produced almost to the posterior margin of the segment, are more closely approached, and separated by a narrower and longer incision. This incision, however, is wider than in specimens of corresponding size of *G. calcarata*, and the tips on both sides are simple, not bifid as in *G. calcarata*. However, Sars in his fig. 5 on Plate III draws an accessory terminal spine on the outer side of the left tip, while the right tip is entire. In our specimens I have never seen a condition like this. Our largest individual (Station No. 2860, 119 mm.) has the epimeral plate similar to that shown in our fig. 1b on Plate II, but it is slightly shorter and the outer margin is more evenly rounded, not angular, as in the latter.

The characters given under 1, 3, and 4 are most important, and according to my experience always hold good. Characters 2 and 5 are not so reliable, although they may prove to be of some help. With regard to the relative length of the rostrum and the spines of the carapace, again the fact will have to be stated that they all are comparatively longer in young specimens, as I have already pointed out. The epimeral plate of the sixth abdominal segment, although different from that of *G. calcarata*, is not very reliable on account of the marked changes in shape taking place during development.

Our largest specimen (Station No. 2860) is 119 mm. long; and is a female with the marsupial pouch fully developed. Sars's specimen was a male, 142 mm. long. Our second largest individual (Station No. 2741) is an immature female about 90 mm. long, with small, but distinct marsupial lamellæ, which do not form a "pouch." All other specimens that have come under my observation are much smaller; the one from Hawaii is 50 mm., another from Sitka Sound, Alaska, (to be described elsewhere) is 55 mm. long, and the present young one from Station No. 3329 is 56 mm. long. They have no traces of marsupial lamellæ, and have been regarded by me as males. But I am not quite sure as to this point. They may be young females. The two specimens from Station No. 3340 consist of two badly damaged carapaces with remnants of the trunk, while in both the abdomen is entirely missing. However, they undoubtedly belong to this species, since characters 1 and 3 are clearly observable.

*Localities represented in the U. S. National Museum.*

FROM U. S. BUREAU OF FISHERIES STEAMER *Albatross* STATIONS.

2741.—1 female adult. Between Cape Charles and Long Island; 852 fathoms.

2860. —1 female. Between Sitka and Columbia River; 876 fathoms.

3329.—1 young. Bering Sea; 399 fathoms.

3340.—2 specimens (damaged). Between Unalaska and Kadiak; 695 fathoms.

*Previous records.*—West of Azores, 2,200 fathoms (Sars); Hawaiian Islands, vicinity of Kauai Island; 850–767 fathoms (Ortmann).

Another locality is off Sitka Sound, Alaska, 922 fathoms.

6. GNATHOPHAUSIA DREPANEPHORA Holt and Tattersall.

*Gnathophausia drepanephora* HOLT and TATTERSALL, Rep. Fisheries Ireland, Pt. 2, Append. No. 4, 1905, p. 113, pl. xviii; Ann. Nat. Hist. (7), XVI, 1905, p. 9, pl. II.

I have not seen this species, but I strongly suspect that it is only the young stage of *G. gigas*.

Holt and Tattersall create for it a separate section of the genus, uniting characters of the two main divisions; it agrees in every respect with our first division (*a* of the key), with the exception that the epimera of the sixth abdominal segment are said to be not united ventrally.

Disregarding the latter character, *G. drepanephora* agrees in every particular with *G. gigas*, making allowance for the much less advanced age of the former (only 39 mm.); thus the spines of the carapace, chiefly the postero-dorsal and the postero-laterals are much more developed relatively. Further, in *G. drepanephora*, the epimera of the five anterior abdominal segments are described and figured as possessing only a posterior lappet, which is produced and spiniform while the anterior lappet is absent. This also may be due to age.

As regards the epimera of the sixth abdominal segment, Holt and Tattersall describe them as not united ventrally. We have seen above, under *G. gigas*, that in young individuals (56 mm. long) these parts are not completely united in the median line, and thus it appears possible that *G. drepanephora* represents only a stage that is younger yet than the youngest known specimen of *G. gigas*.

Lack of material of the young of *G. gigas* prevents the settlement of this question finally, but I am inclined to regard *G. drepanephora* as the young stage of *G. gigas*.

*G. drepanephora* has been found off the western coast of Ireland, latitude 52° 27' 06" north; longitude 15° 40' west, in 1,770 fathoms.



## 7. GNATHOPHAUSIA GRACILIS Willemoes-Suhm.

*Gnathophausia gracilis* WILLEMOES-SUHM, Trans. Linn. Soc.<sup>o</sup> London (2) I, 1875, p. 33, pl. IX, fig. 1.—G. O. Sars, Forh. Selsk. Christiania, 1883, no. 11; Rep. Challenger, XIII, 1885, p. 48, pl. VII, figs. 6–10.

*Gnathophausia gracilis* var. *brevispinis* WOOD-MASON and ALCOCK, Ann. Nat. Hist. (6), VII, 1891, p. 188.

*Gnathophausia brevispinis* WOOD-MASON and ALCOCK, Ann. Nat. Hist. (6), VII, 1891, p. 269.—FAXON, Mem. Mus. Comp. Zool., XVIII, 1895, p. 216, pl. J.

*Gnathophausia dentata* FAXON, Bull. Mus. Comp. Zool., XXIV, 1893, p. 217.<sup>a</sup>

Carapace with keels and spines of the type of the first group, but upper lateral keel entirely absent. Lower lateral keel terminating in a spine at the postero-inferior angle of the carapace. There is another smaller spine just below this one, which is directed outward and sometimes obsolete. Median keel interrupted, its posterior part with spiniform serrations. Postero-dorsal spine short. From the anterior end of the posterior part of the dorsal keel a pair of oblique keels runs forward and downward. Anterior part of dorsal keel triangularly elevated upon the gastric region, forming a prominent dentate crest, which extends forward to the rostrum. Supraocular spines small; antennal spines larger; branchiostegal spines very large.

Antennal scale of the type of the second group, large, of usual shape, formed by a lanceolate-ovate lamella, the outer margin of which has a strong spine, which is serrated at the outer edge and projects slightly beyond the terminal lobe of the lamellar part.

Abdomen of the general type of the second group, but peculiar on account of the great development of dorsal spines. The first and second segments have each 2 large, triangular spines in the median line, the posterior of them at the posterior margin of the segment; the anterior spine of the first segment is generally smaller than the posterior. The following 3 segments (third to fifth) have each a posteriorly projecting spine on the posterior dorsal end. The two lappets of the epimera of the first to the fifth segments are short and pointed, the posterior slightly longer than the anterior.

Epimera of the sixth abdominal segment of the type of the second group, not united ventrally to form a ventral plate. There are 2 triangular, pointed epimeral lappets on each side of the anterior part of the sixth segment.

I do not entertain the slightest doubt that *G. brevispinis* Wood-Mason and Alcock, is identical with *G. gracilis* Suhm. Faxon<sup>b</sup> admits the following differences of *G. brevispinis* from *G. gracilis*:

1. Prominent, dentate gastric crest.

<sup>a</sup>The *Gnathophausia* figured on the colored plate opposite p. 500 in Chun, Aus den Tiefen des Weltmeeres, 1900, resembles this species, except for the spine just back of the cervical groove.

<sup>b</sup>Mem. Mus. Comp. Zool., XVIII, 1895, p. 218.

2. Small size (or even absence) of the lower spine of the postero-inferior angle of the carapace.
3. Great breadth of the antennal scale.
4. Pleura of first 4 abdominal segments expanded posteriorly.
5. A transverse fold separating the 2 dorsal spines of the second abdominal segment.

I have to make the following remarks as to these points:

1. According to Willemoes-Suhm, the gastric region of *G. gracilis* has 2 small teeth in the median line; according to Sars, who examined the same individual, it is unarmed. This difference is apparently due to the poor state of preservation of the *Challenger* specimen, and, as Sars's figure is probably inaccurate in this respect, we can not depend on this character.

2. The lower spine of the postero-inferior angle of the carapace is certainly subject to variation. Faxon says that it is sometimes nearly or quite obsolete; my specimen, which agrees in most respects with *G. brevispinis*, has it well developed, although smaller than the upper spine and not quite so large as in Sars's figure. Consequently this character is not reliable.

In the width of the antennal scale I fail to observe any difference between Sars's (Plate VII, fig. 8) and Faxon's (Plate J, fig. 1c) figures. In the latter, it may be slightly wider in the basal part, but this does not constitute a specific difference.

As to 4 and 5 we can not compare *G. brevispinis* with *G. gracilis*, as Sars does not mention these characters. His figures, indeed, do not show the features given for *G. brevispinis*, but it must be borne in mind that this may be due to the poor condition of the *Challenger* specimen. My specimen agrees with *G. brevispinis* in these respects.

The very peculiar association of characters found in both of these species (which are supposed to be distinct) on account of which it is necessary to place them by themselves within the genus, renders it probable, from the start, that they are identical. The above considerations remove any probable necessity for their separation, and hence I have no hesitation in uniting them in one species.

The size of Sars's specimen is 41 mm.; of Wood-Mason and Alcock's 82 and 92 mm.; Faxon gives 60 mm. My specimen is about 60 mm. long, and seems to be a male, since no traces of marsupial lamellæ are present. This species seems to attain a larger size, since the largest specimen known (92 mm.) was an "immature female with the last pair of incubatory lamellæ only 3 mm. long" (Wood-Mason).

*Locality*.—U. S. Bureau of Fisheries steamer *Albatross* station 3128—1 male. Off Central California; 627 fathoms.

*Previous records*.—Atlantic, between Africa and Brazil, latitude  $1^{\circ} 22'$  north, longitude  $26^{\circ} 36'$  west, 1,500 fathoms (Sars); Bay of Bengal, 920–690 fathoms and 1,748 fathoms (Wood-Mason and

Alcock); off Panama, 1,201 and 1,471 fathoms (Faxon); off Galapagos Islands, 551, 1,189, and 1,322 fathoms (Faxon).

If the specimen figured by Chun<sup>a</sup> is this species, we have to add: Gulf of Guinea, 4,000 meters.

#### 8. GNATHOPHAUSIA LONGISPINA G. O. Sars.

*Gnathophausia longispina* G. O. Sars, Forh. Selsk. Christiania, 1883 no. 10; Rep. Challenger, XIII, 1885, p. 46, pl. VII, figs. 1-5; pl. VIII.—ORTMANN, Bull. U. S. Fish Comm. for 1903, Pt. 3, 1905, p. 969.

This species is not represented in the present material, but I had quite a number of specimens when I worked on the Hawaiian material, and thus I am able to give a good account of it.

Carapace with keels of the type of the second group: An upper lateral keel is present; the lower lateral keel curves up behind, and runs toward the postero-dorsal spine. The dorsal keel is continuous, and projects as a long postero-dorsal spine. Rostrum long. Supraocular spines well developed; antennal spine obsolete (very small or even absent); branchiostegal spine well marked and triangular. No postero-inferior spines, but posterior angles of carapace rounded off. (With the exception of the branchiostegal spine, the spines of the carapace are of the type of the second group.)

Antennal scale of the type of the second group, and remarkably long; the marginal spine is greatly produced, projecting considerably beyond the terminal lobe of the lamellar part, and serrated at both the inner and outer margins.

Abdomen of the type of the second group, with a small posteriorly projecting dorsal spine at the hind margin of each of the five anterior segments. Epimera of the five anterior segments with the two lappets acute, the anterior short and small, the posterior longer and spiniform; in the male, the posterior lappet of the second segment is greatly elongated, with a long spiniform tip; in the female, it does not differ essentially from those of the other segments.

Epimera of sixth abdominal segment of the type of the second group, but there are two triangular, acute lappets on each side, as in *G. gracilis*.

The chief specific characters are: The presence of a branchiostegal spine, the shape of the antennal scale, and the character of the abdominal segments. The remarkable posterior lappet of the second abdominal segment is found only in the male sex, and thus males and females may be easily distinguished.

As I have demonstrated with the help of Hawaiian material, the rostrum, the dorsal and branchiostegal spines, and the marginal serrations of the antennal scale change with age, being more strongly developed in young individuals.

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<sup>a</sup> Aus den Tiefen des Weltmeeres, 1900, p. 500.

*Size*.—Sars had 5 specimens, the largest being a male, 59 mm. long. My material from the Hawaiian Islands consisted of 40 specimens, the largest of which was a female, 62 mm. long, with the marsupial pouch fully developed. Since there were other females, in which at about the size of 50 mm. the marsupial lamellæ were well formed, it is probable that this species does not attain the gigantic dimensions seen in others.

*Distribution*. Off Samboangan, Philippines, 250 fathoms (Sars). Not rare at the Hawaiian Islands (found at 15 stations), near the islands of Oahu, Molokai, and in Kaiwi Channel, 222–498 fathoms (Ortmann).

9. **GNATHOPHAUSIA ZOËA** Willemoes-Suhm.

Plate II, fig. 2a, 2b.

*Gnathophausia zoëa* WILLEMOES-SUHM, Nature, VIII, 1873, p. 401, fig. 6; Trans. Linn. Soc. London (2), I, 1875, p. 32, pl. xix, figs. 2–15; pl. x, fig. 4.—A. MILNE-EDWARDS, Rec. fig. Crust. nouv., I, 1883.—G. O. SARS, Rep. Chall., XIII, 1885, p. 44, pl. vi, figs. 6–10.—FAXON, Mem. Mus. Comp. Zool., XVIII, 1895, p. 215.—CAULLERY, Ann. Univ. Lyon, fasc. 2, 1896, p. 368.—ALCOCK and ANDERSON, Ann. Nat. Hist. (7), III, 1899, p. 3.—HOLT and TATTERSALL, Rep. Fisheries Ireland, II, App. 4, 1905, p. 141.—HANSEN, Bull. Mus. Monaco, XXX, 1905, p. 5.

*Gnathophausia willemoesi* G. O. SARS, Forh. Selsk. Christiania, 1883, no. 6; Rep. Challenger, XIII, 1885, p. 38, pl. v, figs. 1–6.—FAXON, Mem. Mus. Comp. Zool., XVIII, 1895, p. 215, pl. k, fig. 1.—ORTMANN, Bull. U. S. Fish. Comm. for 1903, Pt. 3, 1905, p. 969.

10. **GNATHOPHAUSIA ZOËA Sarsi** (Wood-Mason).

*Gnathophausia sarsi* WOOD-MASON, Ann. Nat. Hist. (6), VII, 1891, p. 187.—ORTMANN, Bull. U. S. Fish. Comm. for 1903, Pt. 3, 1905, p. 969.

The following are the characters of the species:

Carapace with keels and spines of the type of the second group: upper lateral keel present; lower lateral keel curved up behind; dorsal keel continuous. Rostrum, according to age, longer or shorter. Dorsal spine long in the young; shorter in the old. Supraocular and antennal spines well developed; branchiostegal spine absent, and branchiostegal lobe rounded. No postero-inferior spines, but postero-inferior angle of carapace rounded off or (in the variety) rectangular, forming a narrow laminar expansion behind the marginal rim, which also curves upward. The carapace is not suddenly constricted in the anterior part.

Antennal scale of the type of the second group: large, spine of outer margin projecting slightly beyond the terminal lobe of lamellar part in the young, slightly shorter than the latter in the old. Outer margin of spine slightly serrated in the young, smooth in the old.

Abdomen of the type of the second group: the five anterior segments dorsally indistinctly keeled, and produced into small spines at



the posterior margin. Epimera of the five anterior segments, with the anterior lappet small, the posterior produced and acutely pointed. There is, on each segment, an indistinct subdorsal keel on each side.

Epimera of sixth abdominal segment of the type of the second group, formed by only one triangular, acute lappet on each side of the anterior section of the segment, and not forming a ventral plate.

The only difference of the variety *sarsi* from the typical form is found in the shape of the lamellar expansion of the postero-inferior angle of the carapace: in the typical form, this expansion is rounded off, while in the variety it is rectangular. It is possible that the latter character is only restricted to the young, and that it generally disappears with advancing age, but then it would disappear at different stages in different individuals, in the average, when they are about half grown (see below).

*The identity of G. zoëa and G. willemoesi.*—I have devoted much time to the study of the differential characters of these two species, as determined by Sars (1885), and have the following to say with reference to them:

In Sars's synopsis of the species (p. 29), the length of the postero-dorsal spine is paramount: it is "greatly produced" in *G. zoëa*, and "comparatively short" in *G. willemoesi*.

The differences between the species, taken from Sars's diagnosis and description (pp. 38 and 44) are the following:

1. The length of the postero-dorsal spine just mentioned: in *G. zoëa* this spine reaches sometimes beyond the fourth abdominal segment, while in *G. willemoesi* it is only slightly longer than the first abdominal segment.

2. The posterior margin of the carapace, and the margins of the postero-dorsal spine are "coarsely denticulate" in *G. zoëa*, and "decidedly glabrous" in *G. willemoesi*.

3. The rostrum is very elongate (even exceeding the carapace without posterior spine), and strongly denticulate in *G. zoëa*; it is shorter than the carapace, and provided with small, comparatively few, denticles in *G. willemoesi*.

4. The spine of the antennal scale projects somewhat beyond the terminal lobe of the lamellar part, and is slightly denticulate at the outer edge, in *G. zoëa*; it is a little shorter than the terminal lobe, and not denticulate, in *G. willemoesi*.

Discussing these four points in detail:

1. Sars seems to lay much stress upon this character. I have shown, however, in several of the foregoing species, that the relative length of the spines of the carapace changes with age, being generally longer in young individuals. As regards the present case, *G. zoëa* is founded upon specimens much younger than those of *G. willemoesi*. Moreover, I have extracted embryos from the marsupial pouch of a large

specimen (from Station No. 2723, about 105 mm. long), which undoubtedly belongs to *G. willemoesi* according to Sars's conception, and these young ones (Plate II, fig. 2a) have the postero-dorsal spine well developed, and comparatively much longer than any specimens ever described, extending to about the middle of the telson. Thus the length of the postero-dorsal spine depends without question on the age of the individual.

2. The denticulations or serrations of the posterior margin of the carapace, the postero-dorsal spine, the spines of anterior margin of carapace, and of the rostrum are generally in this genus more distinct in younger individuals than in older ones. I have called attention to this above (under *G. calcarata*). In the present case the large individual from Station No. 2723, which is surely *G. willemoesi*, has the margin of the carapace not "decidedly glabrous," as Sars states, but there are a number of fine denticulations, less distinct than in young individuals, but easily seen. Faxon (1895) says that in *G. willemoesi* there are denticulations along the margin of the dorsal spine. Thus this character does not hold.

3. That the relative length of the rostrum, like that of the spines of the carapace, changes with age is now well established. In the young specimens extracted from the pouch of the mother, the rostrum is decidedly longer than the carapace (Plate II, fig. 2a). If the rostrum becomes shorter with age it is not astonishing that the denticulations become less pronounced, and this is entirely in keeping with what I have shown in the second character. Thus the length of the rostrum does not possess any systematic value.

4. The fourth character needs special attention, but I think I am able to prove that it also is influenced by age. In young specimens the spine of the outer margin of the antennal scale is longer than the terminal lobe, and it is slightly serrated on the outer edge. With increasing age it becomes slightly shorter than the terminal lobe, and the serrations disappear. The following may be said in support of this view:

a. The specimens representing the original *G. zoëa* are small or of medium size (not longer than 70 mm.), while the specimens upon which *G. willemoesi* was founded are very large, one measuring 136 mm., and the other being "somewhat smaller;" that is to say, they were about double the size of *G. zoëa*.

b. A large specimen (Station No. 2723) is about 105 mm. long, and has the antennal scale of *G. willemoesi*; another (Station No. 4306) is 88 mm. long, and has the antennal scale intermediate between *G. zoëa* and *willemoesi*; the spine is about as long as the lamellar portion on the left side and very slightly longer than the latter on the right side, and it has on the outer margin very indistinct indications of serrations, visible only under the microscope. *The latter specimen is*

also intermediate with regard to the characters 1, 2, and 3. Younger individuals among the material examined by the writer possess invariably the antennal scale of *G. zoëa*, but it must be added that the serrations of the outer margin are very fine. I can not see them with the naked eye, and an ordinary magnifying lens scarcely shows traces of them, but stronger instruments reveal them distinctly as sharp points for quite a distance along the margin of the spine.

c. Young specimens extracted from the marsupium of a typical *G. willemoesi* have an antennal scale, which, in shape, is that of *G. zoëa*, the marginal spine being longer than the lamellar portion. However, I could not ascertain the presence of serrations on the margin. Under the microscope, there is a kind of undulation of the margin, but no sharp, spiniform teeth. But this is not astonishing, since it is in keeping with the fact, that the serrations or denticulations of rostrum and postero-dorsal spine are not present in these embryonic individuals, while they are well developed in young specimens after they have left the marsupium.

d. Similar changes in the length of the spine of the antennal scale, due to age, have been found in another species, *G. longispina*.

Thus, I think, the assumption well supported, that the characters given for *G. zoëa* are only such as are due to the immaturity of the specimens, and that those assigned to *G. willemoesi* belong to the older stages of the same species. The name of *G. zoëa* has the priority over *G. willemoesi*.

*G. sarsi*.—For *G. sarsi*, the following differences from *G. willemoesi* are given by Wood-Mason<sup>a</sup>.

1. The dorsal spine reaches to the posterior end of the third abdominal segment.

2. "Extreme edge (of carapace) expanded at the postero-inferior angle into a conspicuous rectangular lamina, into which neither its lower lateral keel nor its raised rim enters."

3. Upper half of the posterior margin of the carapace on each side and the lateral edges of the dorsal spine are minutely denticulated.

4. Five anterior abdominal segments with two subdorsal keels.

5. The telson is tricarinate, having a fine median carina, and "appears to be more produced at the tip than in any other species."

The following remarks are to be made:

1. As I have already shown, the length of the dorsal spine can be disregarded; in the present case, the length agrees well with the size of Wood-Mason's specimen; in the typical *G. zoëa*, not longer than 70 mm., it reaches beyond the fourth abdominal segment or falls short of it; in *G. sarsi* (75 mm.) it reaches to the end of the third segment; in one of our specimens, 88 mm. long, it reaches to the middle of the third segment; in another, about 105 mm. long, to the middle of the

<sup>a</sup> Ann. Nat. Hist. (6), VII, 1891, p. 187.

second; and in the type of *G. willemoesi*, 136 mm. long, slightly beyond the first segment. In the larva before leaving the marsupium, as has been said, it reaches to the middle of the telson, and thus the length of this spine entirely depends upon age.

2. The second is the most important character of *G. sarsi*, and I find it in all the younger individuals at hand. The lower lateral keel, and also the marginal keel or rim, curve upward near the postero-inferior angle of the carapace; but the actual margin of the carapace extends behind the point, where the marginal rim begins to curve up, and runs for a short distance straight back; then it forms a right angle, extending toward the dorsal spine. Thus there is, behind the marginal rim, a "rectangular lamina" as described by Wood-Mason.

Sars does not mention such a structure, neither in *G. willemoesi* nor in *G. zoëa*, he only says that the lower lateral keel curves upward before reaching the postero-inferior corner, and that the latter, in *G. willemoesi*, is evenly rounded off. He does not mention the fact, that the marginal rim curves upward before reaching the posterior margin, and that there is a "lamina" behind the marginal rim. Such a lamina, however, is distinctly seen in Sars's figures of *G. willemoesi* and *zoëa* (Plate V, fig. 1, and Plate VI, fig. 6). This is the more important, and clearly establishes the presence of this lamina in Sars's specimens, although he did not pay much attention to this feature, he gave a fair representation of it in the figures. The lamina, however, in both cases, is not rectangular, but evenly rounded off.

Looking at the specimens at hand, I find that the largest, a typical *willemoesi*, represents this character as described and figured by Sars, only the lamina is somewhat wider than in his figure; but it is evenly rounded off. Exactly the same condition obtains in our second largest individual, 88 mm. long. From the Hawaiian Islands I have mentioned two specimens of *G. willemoesi*, which I identified chiefly according to this character, which measure 73 and 52 mm. The largest individual observed by myself among the Hawaiian material, possessed a rectangular lamina, and consequently was recorded under *G. sarsi*. It measured 62 mm. The smallest measured 34 mm.

Considering that Wood-Mason's *G. sarsi* was 75 mm. long, and that Sars's specimens of *G. zoëa*, which have apparently a rounded lamina, were 70 mm. and less, the conclusion is reached that all specimens hitherto observed that are over 75 mm. long, have this character developed according to the *willemoesi* type; all specimens smaller than 52 mm. have it corresponding to the *sarsi* type; specimens between 52 and 75 mm. may possess either a rectangular or a rounded lamina.

But it can not be said positively that this character is due only to age. It may be that the rectangular lamina becomes rounded with advancing age, and that this transition takes place at a different period in different individuals, in the average, when they are about half grown



(50 to 70 mm.). But I am not quite sure of it, and so I prefer, for the present, to regard *G. sarsi* as a variety of *G. zoëa* (= *willemoesi*). It should be mentioned that Faxon<sup>a</sup> thinks that *G. sarsi* is "a form probably not specifically distinct from *G. willemoesi*."

The young specimens extracted from the pouch of the old female show a distinct angle or point behind on each side of the carapace, but as the carapace is rather shapeless, being represented by a kind of a bag filled partly with oily or fatty substance (yolk), it is impossible to correlate these two small points with the infero-posterior corners of the carapace, although this correlation is very probable.

3. I have shown that the denticulation of the posterior margin of the carapace and of the dorsal spine does not constitute a specific character.

4. The subdorsal keels of the abdomen, mentioned by Wood-Mason, are present in all specimens at hand. They are formed by rather faint, blunt elevations, and I should not call them keels. They are easily overlooked, especially in poorly preserved material.

5. A third, fine median keel of the telson is distinctly seen in Sars's illustration of the telson of *G. willemoesi* (Plate V, fig. 6), and is present in all specimens examined by myself. On closer examination I find that this median keel is rather a fine double keel.

Wood-Mason's sentence that the telson "appears to be more produced at the tip than in any other species" is, as I have already remarked in the report on the Hawaiian Schizopods, unintelligible to me. I do not see any difference from other species in the shape of the telson.

*Localities represented in the U. S. National Museum.*

FROM U. S. BUREAU OF FISHERIES STEAMER *Albatross* STATIONS.

GNATHOPHAUSIA ZOËA.

2723—1 female (gravid). Between Nantucket and Cape Charles, 1,685 fathoms.

4306—1 male. Off San Diego, California, 207–497 fathoms.

GNATHOPHAUSIA ZOËA SARSI.

2351—1 young. Between Havana and Yucatan; 426 fathoms.

*Previous records.*

*Typical form, as G. zoëa:* West of Azores, 1,000 fathoms (Sars); Tropical Atlantic, 1° 47' North, 24° 23' West, 1,850 fathoms (Sars); off Brazil, 770 fathoms (Sars); Pacific, north of Kermadec Island, 600 fathoms (Sars); off Galapagos Islands, 384 and 581 fathoms (Faxon);

<sup>a</sup>Mem. Mus. Comp. Zool., XVIII, 1895, p. 215.

Bay of Biscay, 800-1,200 meters (A. Milne-Edwards and Caullery); west coast of Ireland, 382-600 fathoms (Holt and Tattersall); Azores, 1,000 meters (Hansen); near Maldive Islands, 430 fathoms (Alcock and Anderson). *Typical form, as G. willemoesi*: Banda Sea, 1,425 fathoms (Sars); Gulf of Panama, 1,270 fathoms (Faxon); off Acapulco, 493-664 fathoms (Faxon); Tres Marias Islands, 680 fathoms (Faxon); Hawaiian Islands, Molokai and Hawaii, 552-809 fathoms (Ortmann).

*G. zoëa sarsi*: Bay of Bengal, 840 fathoms (Wood-Mason); Hawaiian Islands, vicinity of Kauai and Modu Manu, 293-800 fathoms (Ortmann).

#### THE LARVAL FORM OF GNATHOPHAUSIA ZOËA.

As previously mentioned, among the material is a large female of this species, representing Sars's form *G. willemoesi*, which has the marsupial pouch fully developed and filled with larvæ. Since larval stages of this genus have never been described, indeed, since nothing is known about the development, with the exception that on account of the presence of a marsupial pouch and in analogy to *Lophogaster* it is presumed that the development of the young form probably reaches a very advanced stage before it leaves the mother, it is advisable to give here a more detailed account of these young specimens.

The number of the young is 21, a remarkably small number, but agreeing well with what we know about the number of the progeny of deep-sea animals. They are all uniformly developed and represent a very advanced stage, in fact, they are no longer embryos, but have left the egg completely. Probably they were about ready to leave the pouch of the mother, as all parts of the body had attained, in a general way, the condition found in the free swimming form.

Within the pouch the young *Gnathophausiæ* are so arranged that they lie firmly packed together, the head of each directed toward the posterior end and the sternum of the mother, and the tail toward the anterior end of the mother, each overlapping in part the individual in front of it. That is to say, the heads are directed toward the bases, the tails toward the tips of the marsupial lamellæ. The dorsal face of the larvæ is concave, the ventral face convex, corresponding to the curvature of the lamellæ, since the back is turned toward the sternum of the mother, the ventral side toward the enveloping lamellæ.

In each of the young ones (see Plate II, fig. 2*a*) the body is distinctly divided into an anterior (thoracic) and posterior part, which forms a distinctly and completely segmented abdomen. The carapace is represented by a bag-like excrescence, which is provided with distinct and long rostral and postero-dorsal spines. It is filled with the remnant of the yolk. Its keels are very indistinct, but there is a small point posteriorly on each side, possibly representing the postero-inferior corners of the carapace. The dorsal spine is long and closely

appressed to the back of the abdomen, and reaches as far as the middle of the telson. The rostrum is very long, longer than the carapace. It is bent down and appressed toward the ventral side, and directed backward. Neither rostrum nor dorsal spine show any serrations.

All appendages, except the eyes, are closely appressed to the ventral face of the body and are directed backward. In my figure they are not drawn in the natural position, but are slightly spread out and removed from the ventral side in order to show them more distinctly.

The eyes are well developed and of yellowish color. All other appendages resemble more or less those of the adult form, with the general exception that the hairs and bristles are absent or less developed and with the following special exceptions (compare Sars's Plate VIII):

The marginal spine of the antennal scale is longer than the laminar part and has no serrations on the outer margin.

The second maxilla possesses an additional joint at the end of the distal portion of the endognath (called "palp" by Sars, see his fig. 7<sup>p</sup> on Plate VIII). This joint is very small, only about one-fifth as long as the preceding joint (the terminal one in the adult) and less than half as wide. (In the adult it seems to be fused with the penultimate joint, as is indicated by the shape of this joint in Sars's figure.) The "pigmented basal protuberance" (or luminous organ) is indicated in the larva.

The maxilliped resembles Sars's figure (Plate VIII, fig. 8) and also has no exopodite, as is characteristic of the second group of the genus (excepting *G. gracilis*), but it is more slender, the third of the five free joints being not enlarged and about half as wide as in the adult *G. longispina*.

The gills are vestigial and less complex than in the adults.

The tip of the telson has not yet assumed the shape of the adult form (see Plate II, fig. 2*b*). It is not terminated by two strongly-curved spines forming an "almost semilunar" projection, but is terminated by a cordiform or, rather, reniform plate, which carries on each side a larger and a smaller spine and is finely denticulate at the posterior border. The marginal spines of the telson are more uniform than in the adult form, only a few smaller spines being found between the larger ones.

It appears that these larvæ come very near to the adult form, only the carapace remaining what might be called "embryonal" in shape. From the presence of a marsupial pouch it was to be expected that the young reach a high stage of development before being set free and dismissed from the mother's protection. As it happens this has been fully confirmed by the present study, the young contained in the pouch of the mother having passed completely through all embry-

onal stages, and through almost all larval stages; they seem to be ready to leave the marsupium, for it is clear that they need only to stretch out their appendages in order to be able to use them for free swimming.

## 11. GNATHOPHAUSIA SCAPULARIS, new species.

Plate II, fig. 3a-3c.

*Type and cotype*.—U. S. National Museum, 2 males, U. S. Bureau of Fisheries steamer *Albatross*, Station No. 2992; Revillagigedo Islands, Lower California; 460 fathoms. Cat. No. 32327.

Near *G. zoëa*, but easily recognized by the anterior constriction of the carapace and the greatly expanded branchiostegal lobes.

Shape of body rather stout. Carapace covering almost completely the first abdominal segment. Postero-dorsal spine indistinctly denticulate toward posterior margin of carapace, rather short, projecting to about the middle of the second abdominal segment. Rostrum short, much shorter than carapace, denticulate. Supraocular spines strong. Antennal spines small, but distinct. Branchiostegal spines wanting. All keels of carapace well developed. Median keel uninterrupted. Upper lateral keels strong, curved, including a lanceolate, almost plane upper face of the carapace, widest anteriorly. Anterior ends of upper lateral keels strongly curved downward. In front of the anterior ends of these keels the carapace is suddenly constricted and depressed, thus forming a very marked shoulder on each side. This constriction affects greatly the course of the lower lateral keels, which suddenly begin to converge at a point just above the branchiostegal lobes. Above this point and below the anterior end of the upper lateral keel there is an almost pit-like depression, which sends a slight groove upward, toward the median keel. For the rest, the lower lateral keel is similar to that of *G. zoëa*, curving up behind toward the postero-dorsal spine. It projects, however, in its whole length, considerably beyond the keel of the lower margin of the carapace. Thus the whole carapace becomes rather prismatic, almost hexangular, the upper face being flat, but interrupted by the dorsal keel, and the lower surface being wanting (between the two lower margins); compare the cross section of the carapace, Plate II, fig. 3c.

Branchiostegal lobes rounded, vault-shaped, and greatly expanded, rendering the carapace at this point as wide as in the middle, in spite of the great constriction above the branchiostegal lobes.

Abdomen very similar to that of *G. zoëa*, practically identical with it. Five anterior segments slightly keeled dorsally, with a small, posteriorly projecting spine at the hind margin. On each side a blunt sub-dorsal keel. Epimera with the anterior lappet small and rounded or slightly angular; the posterior lappet produced into a sharp spine.



There is a small spine at the base of the basal joint of the pleopods (as in *G. zoëa*). Only one epimeral spine on each side of anterior section of sixth abdominal segment.

All other parts are similar to the corresponding parts of *G. zoëa*, but the antennal scale has the marginal spine considerably shorter than the terminal lobe, without serrations on the outer edge.

This very remarkable species is so closely allied to *G. zoëa* that I should have taken the peculiar conformation of the carapace, caused by the constriction of its anterior part, for a monstrosity, were it not for the fact that two individuals are at hand. The comparatively short spine of the antennal scale possibly constitutes another specific character; in specimens of *G. zoëa* of the same size it is longer than the terminal lobe.

Both specimens are apparently males, since no traces of marsupial lamellæ are visible, and the coxopodite of the last pair of thoracic legs has, posteriorly, a small tubercle, which undoubtedly represents the male orifice.

*Measurements of the types.*—Total length of larger individual, 75 mm.; length from tip of rostrum to tip of posterior spine of carapace, 46 mm. Total length of smaller individual, about 70 mm., but exact figures can not be given, since the rostrum is broken off near the base.

#### 12. GNATHOPHAUSIA AFFINIS G. O. Sars.

*Gnathophausia affinis* G. O. Sars, Forh. Selsk. Christiania, 1883, no. 7; Rep. Challenger, XIII, 1885, p. 41, pl. v, figs. 7-10.

I have never seen this species. It is very closely allied to *G. zoëa*, and differs only in the following points:

1. Supraocular and antennal spines smaller, the latter almost obsolete. Branchiostegal lobe slightly angular, but having no spine.
2. Abdominal segments not keeled above, and possessing no dorsal projections or spines on the hind margin.
3. Posterior lappet of the epimera of the five anterior abdominal segments rounded, not spiniform.

*Distribution:* Only one specimen, a female, of this species is known up to the present time, the one taken by the *Challenger* in the tropical Atlantic Ocean, midway between Africa and Brazil (latitude  $1^{\circ} 22'$  north, longitude  $23^{\circ} 36'$  west), in 1,500 fathoms. It measured 81 mm.

#### 13. GNATHOPHAUSIA ELEGANS G. O. Sars.

*Gnathophausia elegans* G. O. Sars, Rep. Challenger, XIII, 1885, p. 42, pl. vi, figs. 1-5.

Carapace with keels and spines of the type of the second group, but upper lateral keel absent. Lower lateral keel curving up behind and much farther distant from the marginal rim than in *G. zoëa*. Dorsal

keel continuous. Rostrum and dorsal spine comparatively long. Supraocular spine well developed. Antennal spine very small, almost obsolete. Branchiostegal lobe rounded or angular, but without spine. No postero-inferior spines. Marginal rim following closely the margin and leaving no laminar expansion at the postero-inferior corner. Carapace not constricted in anterior part.

Antennal scale of the type of the second group and very similar to that of the young *G. zoëa*; it is large, and the spine on the outer margin is slightly longer than the laminar portion. The outer edge with very minute serrations in young specimens, smooth in older ones.

Abdomen of the type of the second group, at least in the young, but the five anterior segments without median keel, although with short, flattened, spiniform projections at posterior dorsal margin. In older individuals these dorsal projections are wanting. Epimera of all abdominal segments similar to those of *G. zoëa*.

The young specimen at hand differs from Sars's original description in the following particulars:

1. The carapace completely covers the trunk.
2. The rostrum and the postero-dorsal spine are longer.
3. Branchiostegal lobe not rounded, but angular.
4. Five anterior abdominal segments with flattened median posterior projection.
5. Spine of antennal scale finely serrated on outer margin.

The first, second, and fifth characters are of no consequence, since similar variations are found in other species, and are plainly due to state of preservation or to age. Our specimen is young, 48 mm. long, while Sars's was 56 mm.

The angular (triangular) shape of the branchiostegal lobe (third character) differs markedly from what is seen in Sars's species, and the presence of flattened spines on the posterior margins of the abdominal segments (fourth character) might also be of importance. Since the present specimen is only the second individual of this species ever reported, I am not prepared to say whether these two characters are of specific or varietal value, or whether they simply constitute additional variations of age. Further material is necessary to decide this question.

*Locality*.—U. S. Bureau of Fisheries steamer *Albatross* Station No. 3697, 1 young; off Honshu Island, Japan; 265 to 120 fathoms.

*Previous record*.—South of Fiji Islands, 610 fathoms (Sars).

## Family EUCOPIIDÆ G. O. Sars.

## 14. EUCOPIA AUSTRALIS Dana.

*Eucopeia australis* DANA, U. S. Expl. Exp. Crust., 1852, p. 609, pl. XL, fig. 10.—  
HANSEN, Bull. Mus. Monaco, XLII, 1905, p. 6.

The species of this genus have been largely confounded, as has been pointed out by Hansen. The following specimens all agree with *E. australis* Dana, as reidentified by that author. All my specimens are in poor state of preservation, but the eyes are present in all of them.

The distribution of this form can not be made out satisfactorily until the older material has been reexamined. It is known from the Antarctic Ocean (Dana, Hansen), and the present localities are of interest, since they extend the range into the northern Pacific and tropical Atlantic oceans.

*Localities represented in the U. S. National Museum.*FROM U. S. BUREAU OF FISHERIES STEAMER *Albatross* STATIONS.

- 2751.—1 young. Lesser Antilles, latitude  $16^{\circ} 54'$  north; longitude  $63^{\circ} 12'$  west; 687 fathoms.  
 3308.—6 specimens (3 female, 3 young). Bering Sea, latitude  $56^{\circ} 12'$  north; longitude  $172^{\circ} 07'$  west; 1,625 fathoms.  
 3604.—1 male. Bering Sea, latitude  $54^{\circ} 54'$  north; longitude  $168^{\circ} 59'$  west; 1,401 fathoms.  
 3696.—1 young. Off Houshu Island, Japan; 501 to 749 fathoms.  
 3783.—1 female. Off Kamchatka; 1,567 fathoms.  
 4397.—1 young. Off Santa Catalina Islands, California; 2,196 to 2,228 fathoms.  
 4403.—2 females, 1 young. Off San Clemente Island, California; 505 to 599 fathoms.

## 15. EUCOPIA UNGUICULATA Willemoes-Suhm.

*Eucopeia unguiculata* HANSEN, Bull. Mus. Monaco, XLII, 1905, p. 3.

A single individual, female, about 30 mm. long, belongs to this species. It is rather well preserved, and the characters pointed out by Hansen for this species are present.

*Locality*.—The U. S. Bureau of Fisheries steamer *Albatross* Station No. 4383, 1 female. Off North Coronado Island, California; 287 to 395 fathoms.

Found previously in the Atlantic Ocean and East Indian Archipelago (Hansen).

## EXPLANATION OF FIGURES.

## PLATE I.

- Fig. 1a. *Lophogaster spinosus*, new species. Type from U. S. Bureau of Fisheries steamer *Albatross* Station No. 2666. View from above, 2/1.
- Fig. 1b. The same. Lateral view of carapace, 2/1.
- Fig. 2a. *Gnathophausia calcarata* Sars. Epimeral plate of sixth abdominal segment of a specimen, 42 mm. long, from Station No. 3627, about 4/1.
- Fig. 2b. The same, of a specimen, 55 mm. long, from Station No. 2980, about 4/1.
- Fig. 2c. The same, of a specimen, 68 mm. long, from Station No. 2929, about 4/1.
- Fig. 2d. The same, of a specimen, 81 mm. long, from Station No. 2919, about 3/1.
- Fig. 2e. The same, of a specimen, 91 mm. long, from Station No. 4389, about 3/1.
- Fig. 2f. The same, of a specimen, 115 mm. long, from Station No. 3670, about 3/1.

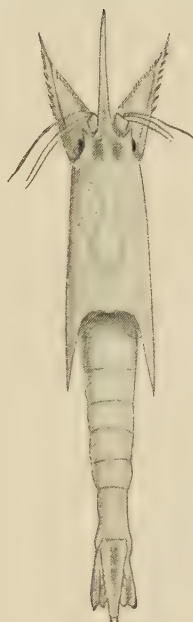
## PLATE II.

- Fig. 1a. *Gnathophausia gigas* Suhm. Epimeral plate of sixth abdominal segment of a specimen, 56 mm. long, from Station No. 3329, about 4/1.
- Fig. 1b. The same, of a specimen, about 90 mm. long, from Station No. 2741, about 3/1.
- Fig. 2a. *Gnathophausia zoëa* Suhm. Larva, extracted from marsupium of mother, from Station No. 2723. Side view, about 3/1.
- Fig. 2b. The same, end of telson, greatly enlarged.
- Fig. 3a. *Gnathophausia scapularis*, new species. Type, from Station No. 2992. Lateral view of body, natural size.
- Fig. 3b. The same. Upper view of carapace.
- Fig. 3c. The same. Diagrammatic cross section of carapace at the level of the line A-B in fig. 3b.





2a



1a



2c



2b



2d



1b



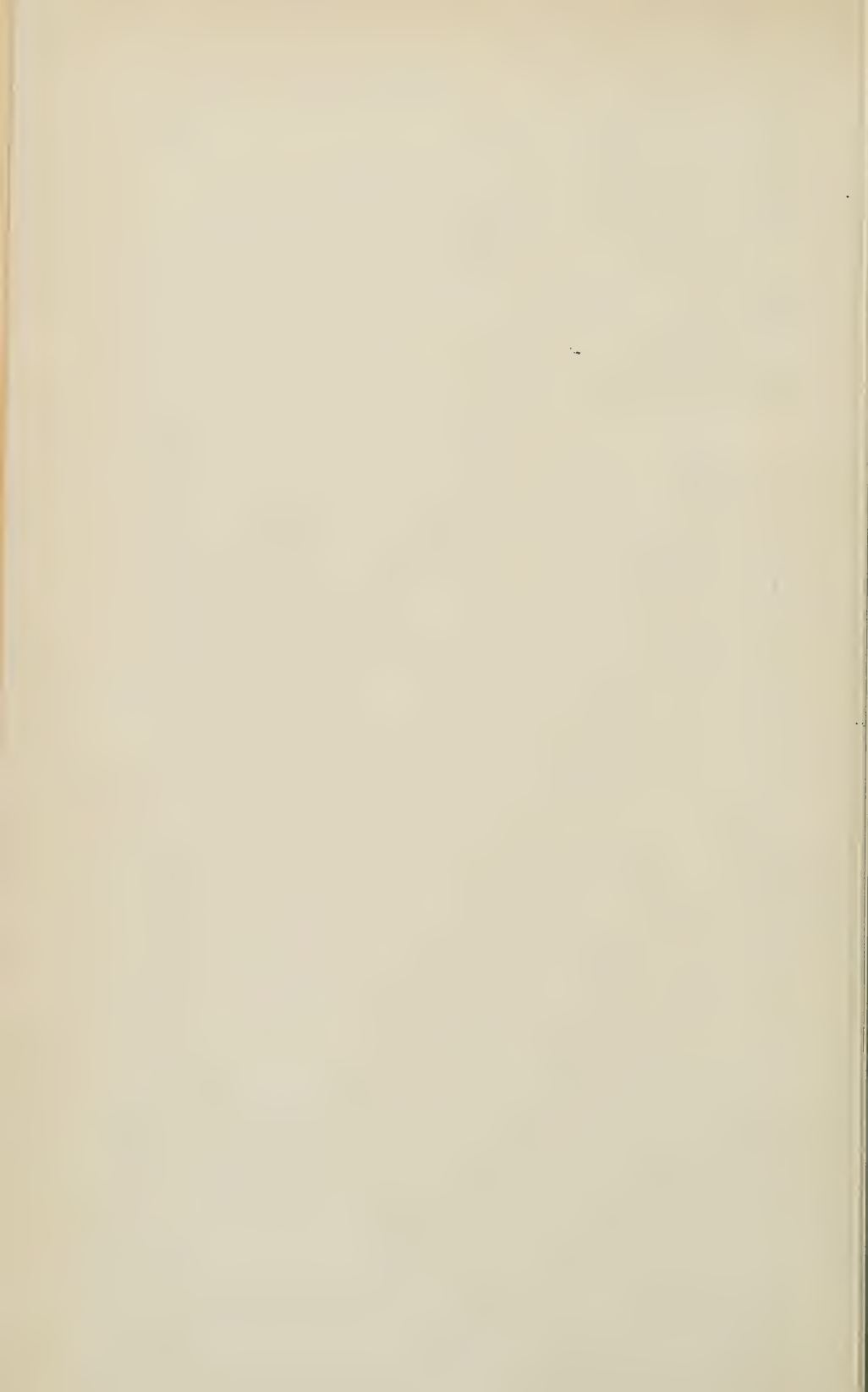
2e

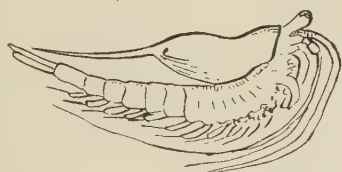


2f

SCHIZOPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 54.





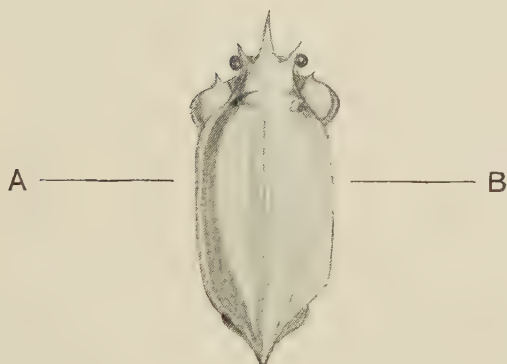
2a



2b



3a



3b



1a



3c



1b

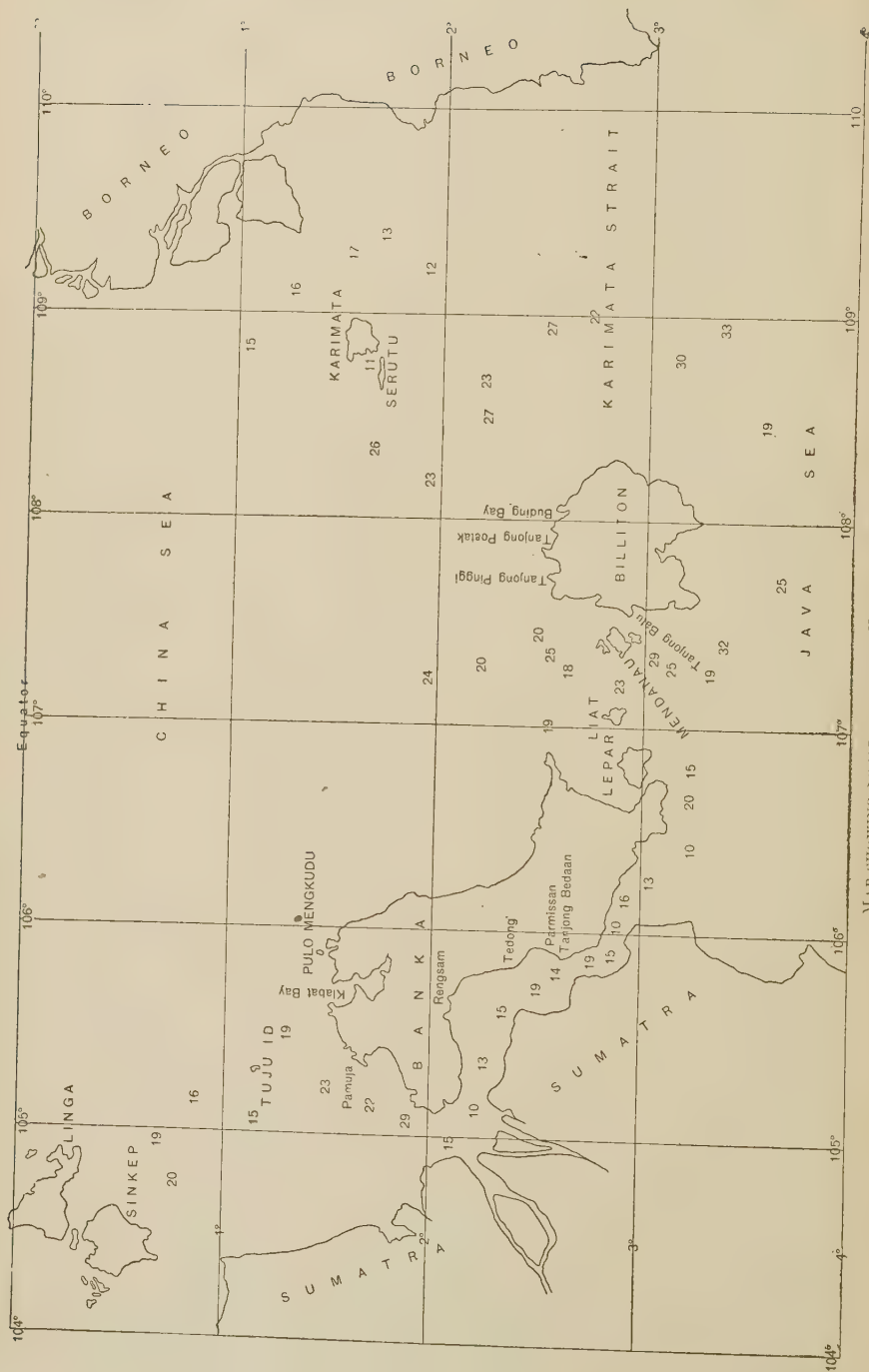
SCHIZOPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 54.









MAP SHOWING LOCATION OF THE KARIMATA ISLANDS.

# MAMMALS COLLECTED BY DR. W. L. ABBOTT IN THE KARIMATA ISLANDS, DUTCH EAST INDIES.

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By GERRIT S. MILLER, Jr.,  
*Assistant Curator, Division of Mammals.*

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The Karimata Islands lie at the northern extremity of Karimata Strait, the wide, reef-beset passage separating the west coast of Borneo from the large island of Billiton. They are about 30 miles southwest of Pulo Maya, on the Bornean coast, and twice this distance northeast of Billiton. On both sides the surrounding water reaches a depth of about 20 fathoms. Karimata, the principal island of the group, is 10 miles across from northeast to southwest, and is nearly as broad along its north coast. In its interior the surface rises to 3,500 feet, while a hill half this height occupies the southwestern region. Pulo Serutu is about a mile wide, and extends in an east and west direction about 7 miles. Though its eastern extremity is only 4 miles from the southwest point of Karimata, Serutu is separated from the larger island by a strait 22 fathoms deep. It is high, rocky, and densely forested, except in some places, where the surface is mostly bare or covered with scrub. In the interior the land reaches an elevation of 1,600 feet. In addition to these two principal islands there are half a dozen islets lying off the northwest extremity of Karimata. The group was visited by Dr. W. L. Abbott during August 16 to September 5, 1904. His collection of mammals, made exclusively on Serutu (August 16 to 19) and Karimata (August 20 to September 5), has been presented to the United States National Museum. It contains 17 species (12 from Karimata only, 3 from Serutu only, and 2 from both islands), 9 of which are new.

## SYSTEMATIC LIST OF SPECIES.

### Family TRAGULIDÆ.

#### TRAGULUS CARIMATÆ, new species.

*Type*.—Young adult female (skin and skull), No. 125062, United States National Museum. Collected at Telok Pai, Karimata Island, August 25, 1904, by Dr. W. L. Abbott. Original number, 3651.

*Characters*.—Externally like *Tragulus kanchil*. Skull slightly larger and broader than in the Sumatran animal and teeth noticeably heavier.

*Color*.—The color so closely resembles that of the Sumatran *Tragulus kanchil* that I can detect no constant differences between the two animals. Among the specimens of *T. carimatæ*, however, occur the individuals with the underparts most strongly suffused with buffy and with the most heavily marked nape stripe.

*Skull and teeth*. The skull does not differ very noticeably from that of *Tragulus kanchil*, except that the specimens average somewhat larger and broader, as may be readily seen on comparing series. The differences in the size of the teeth of the two animals are shown in the following table:<sup>a</sup>

Measurements of *Tragulus kanchil* and *Tragulus carimatæ*.

| Name and locality.             | Cat. No.            | Sex.              | Maxillary tooth row. | Transverse diameter of m <sup>2</sup> . | Mandibular tooth row. |
|--------------------------------|---------------------|-------------------|----------------------|-----------------------------------------|-----------------------|
| TAPANULI BAY, SUMATRA.         |                     |                   |                      |                                         |                       |
| <i>Tragulus kanchil</i> .....  | 114119              | Male adult.....   | mm.<br>31.8          | mm.<br>6.4                              | mm.<br>36.0           |
| Do.....                        | 114120              | .....do.....      | 33.0                 | 6.6                                     | 37.0                  |
| Do.....                        | 114126              | .....do.....      | 31.4                 | 6.2                                     | 35.6                  |
| Do.....                        | 114127              | .....do.....      | 33.0                 | 6.2                                     | 36.6                  |
| Do.....                        | 114121              | Female adult..... | 32.0                 | 6.0                                     | 34.6                  |
| Do.....                        | 114122              | .....do.....      | 33.4                 | 6.0                                     | 36.2                  |
| Do.....                        | 114123              | .....do.....      | 31.0                 | 6.0                                     | 35.0                  |
| Do.....                        | 114124              | .....do.....      | 33.8                 | 6.2                                     | 37.4                  |
| Do.....                        | 114125              | .....do.....      | 32.0                 | 5.8                                     | 36.0                  |
| KARIMATA ISLAND.               |                     |                   |                      |                                         |                       |
| <i>Tragulus carimatæ</i> ..... | 125054              | Male adult.....   | 35.0                 | 6.6                                     | 39.6                  |
| Do.....                        | 125066              | .....do.....      | 35.6                 | 6.4                                     | 39.0                  |
| Do.....                        | 125069              | .....do.....      | 34.8                 | 6.0                                     | 38.0                  |
| Do.....                        | 125055              | Female adult..... | 35.0                 | 7.0                                     | 39.0                  |
| Do.....                        | 125056              | .....do.....      | 36.8                 | 6.8                                     | 39.4                  |
| Do.....                        | <sup>a</sup> 125062 | .....do.....      | 36.0                 | 7.0                                     | 40.0                  |
| Do.....                        | 125063              | .....do.....      | 34.0                 | 6.6                                     | 38.0                  |
| Do.....                        | 125065              | .....do.....      | 35.0                 | 6.8                                     | 39.0                  |

<sup>a</sup> Type.

*Measurements*.—For external measurements see table. Skull of type: Greatest length, 101.6 mm. (94.6)<sup>b</sup>; condylobasal length, 95.6 (88); basal length, 88.6 (82); palatal length, 62.6 (56.8); diastema, 11 (10.4); length of nasals, 28.4 (27.8); greatest breadth of both nasals together, 14.4 (12); zygomatic breadth, 42.4 (41.8); least interorbital breadth, 26.8 (27.6); mandible, 78 (73).

*Specimens examined*.—Sixteen, all from the type locality.

<sup>a</sup> The specimens measured are all adults, with teeth not much worn.

<sup>b</sup> Measurements in parentheses are those of an adult female *Tragulus kanchil* (No. 114421) from Tapanuli Bay, Sumatra.



*Measurements of Tragulus carimatæ.*

| Name and locality.             | Cat. No. | Sex.   | Head and body. | Tail vertebræ. | Hind foot. | Hind foot without hoofs. | Weight. |
|--------------------------------|----------|--------|----------------|----------------|------------|--------------------------|---------|
| KARIMATA ISLAND.               |          |        | mm.            | mm.            | mm.        | mm.                      | kg.     |
| <i>Tragulus carimatæ</i> ..... | 125054   | Male   | 475            | 75             | 125        | 111                      | .....   |
| Do. ....                       | 125060   | do     | 447            | 65             | 118        | 104                      | 1.8     |
| Do. ....                       | 125061   | do     | 467            | 60             | 123        | 111                      | .....   |
| Do. ....                       | 125066   | do     | 458            | 70             | 118        | 108                      | 2.0     |
| Do. ....                       | 125067   | do     | 464            | 70             | 122        | 112                      | 2.2     |
| Do. ....                       | 125068   | do     | 450            | 70             | 120        | 108                      | 2.0     |
| Do. ....                       | 125069   | do     | 450            | 85             | 122        | 112                      | 2.3     |
| Do. ....                       | 125055   | Female | 495            | 75             | 128        | 117                      | 2.6     |
| Do. ....                       | 125056   | do     | 495            | 85             | 126        | 117                      | 2.3     |
| Do. ....                       | 125057   | do     | 480            | 70             | 123        | 112                      | .....   |
| Do. ....                       | 125058   | do     | 470            | 65             | 116        | 108                      | .....   |
| Do. ....                       | 125059   | do     | 450            | 70             | 120        | 107                      | .....   |
| Do. ....                       | a 125062 | do     | 485            | 75             | 130        | 119                      | 2.5     |
| Do. ....                       | 125063   | do     | 455            | 75             | 120        | 106                      | 2.3     |
| Do. ....                       | 125064   | do     | 463            | 70             | 117        | 108                      | 2.3     |
| Do. ....                       | 125065   | do     | 455            | 65             | 123        | 110                      | 2.0     |

a Type.

## Family SCIURIDÆ.

## SCIURUS CARIMATÆ, new species.

*Type*.—Adult male (skin and skull) No. 125076 United States National Museum. Collected at Telok Pai, Karimata Island, August 27, 1904, by Dr. W. L. Abbott. Original number, 3662.

*Characters*.—A member of the *Sciurus prevostii* group resembling *Sciurus mimellus* of the Tambelan Islands, but with size not as much reduced, and with tail distinctly shortened.

*Color*.—Upper parts from muzzle to and including entire tail clear black. Cheeks and sides of neck a grizzled slaty gray, dark enough to throw into slight relief the whitish patch at base of whiskers and the speck on cheek. Lateral stripe buffy white, passing abruptly into light orange-buff, slightly grizzled with gray on shoulder. Dark lateral stripe black, not very well defined. Under parts, feet, inner surface of hind leg, and entire fore leg orange-rufous, fading into orange-buff on upper arm.

*Skull and teeth*.—The skull and teeth resemble those of *Sciurus mimellus*, but are appreciably larger. The rostral portion of the skull in particular is much broadened.

*Measurements*.—For external measurements see table, page 58. Skull of type: Upper length, 53 mm.; condylobasilar length, 46; basilar length, 43; palatilar length, 22; diastema, 12.2; zygomatic breadth, 32.8; interorbital constriction, 21; breadth of brain case above roots of zygomata, 22.8; mandible, 34; maxillary tooth row (alveoli), 9.8; mandibular tooth row (alveoli), 9.4.

*Specimens examined*.—Thirteen, all from Karimata Island.

*Remarks*.—This is a well characterized local species. In color it closely resembles *Sciurus bangkanus*, but in size it more nearly agrees with the geographically more distant *S. mimellus*.

## SCIURUS SERUTUS, new species.

*Type*.—Adult male (skin and skull) No. 125025, United States National Museum. Collected on Pulo Serutu, Karimata Islands, August 17, 1904, by Dr. W. L. Abbott. Original number, 3584.

*Characters*.—A member of the *Sciurus vittatus* group, closely resembling the small *Sciurus aoris* in color, but size about as usual in the larger species.

*Color*.—The color so closely resembles that of *Sciurus aoris*<sup>a</sup> as to require no very detailed description. The upper parts are the same coarse grizzle of black and pale buff. The under parts are, however, somewhat brighter than in the related species, deepening to orange-buff posteriorly; cheeks rather strongly suffused with buff; lateral stripes rather short and wide, the dark stripe slightly washed with color of belly.

*Skull and teeth*.—The skull resembles that of *Sciurus vittatus*, but is rather longer and narrower. Teeth not as large as in the Sumatran animal.

*Measurements*.—For external measurements see table, page 58. Skull of type: Upper length, 48.8; condylobasilar length, 42.6; basilar length, 39; palatilar length, 21; diastema, 11; zygomatic breadth, 28; inter-orbital constriction, 16.8; breadth of brain case above roots of zygomatica, 21; mandible, 31; maxillary tooth row (alveoli), 9; mandibular tooth row (alveoli), 8.

*Specimens examined*.—One, the type.

Measurements of *Sciurus carimatae* and *Sciurus serutus*.

| Name and locality.             | Cat. No.              | Sex.         | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot without claws. |
|--------------------------------|-----------------------|--------------|---------------|----------------|-----------------|------------|--------------------------|
| KARIMATA ISLAND.               |                       |              | <i>mm.</i>    | <i>mm.</i>     | <i>mm.</i>      | <i>mm.</i> | <i>mm.</i>               |
| <i>Sciurus carimatae</i> ..... | 125, 070              | Male.....    | 435           | 225            | 210             | 52.6       | 49.0                     |
| Do. ....                       | 125, 073              | do .....     | 432           | 220            | 212             | 52.0       | 48.0                     |
| Do. ....                       | 125, 075              | do .....     | 445           | 240            | 205             | 55.0       | 50.0                     |
| Do. ....                       | <sup>a</sup> 125, 076 | do .....     | 428           | 243            | 185             | 52.0       | 47.0                     |
| Do. ....                       | 125, 077              | do .....     | 431           | 236            | 195             | 53.0       | 48.6                     |
| Do. ....                       | 125, 108              | do .....     | 450           | 237            | 213             | 55.0       | 52.0                     |
| Do. ....                       | 125, 109              | do .....     | 460           | 235            | 225             | 52.0       | 49.0                     |
| Do. ....                       | 125, 110              | do .....     | 460           | 245            | 215             | 55.4       | 51.4                     |
| Do. ....                       | 125, 071              | Female.....  | 440           | 240            | 200             | 51.0       | 47.0                     |
| Do. ....                       | 125, 072              | do .....     | 435           | 230            | 205             | 53.0       | 49.0                     |
| Do. ....                       | 125, 074              | do .....     | 425           | 230            | 195             | 51.0       | 47.0                     |
| Do. ....                       | 125, 111              | do .....     | 467           | 242            | 225             | 54.0       | 50.0                     |
| Do. ....                       | 125, 112              | do .....     | 435           | 230            | 205             | 53.0       | 49.0                     |
| Do. ....                       | 125, 113              | do .....     | 418           | 248            | 170             | 53.4       | 49.4                     |
| PULO SERUTU.                   |                       |              |               |                |                 |            |                          |
| <i>Sciurus serutus</i> .....   | <sup>a</sup> 125, 025 | Male adult.. | 345           | 215            | 130             | 47.0       | 44.0                     |

<sup>a</sup> Type.

<sup>a</sup> Miller, Smithsonian Miscell. Coll., XLV, p. 10, November 6, 1903.

## Family MURIDÆ.

## MUS NEGLECTUS Jentink?

Four skins from Pulo Serutu and three from Karimata represent a species closely resembling the Bornean *Mus neglectus* Jentink. Without material for direct comparison it is impossible to identify the Karimata form. For measurements, see table, page 60.

## MUS SERUTUS, new species.

*Type*.—Adult male (skin and skull) No. 125032, United States National Museum.

Collected on Pulu Serutu, Karimata Islands, August 17, 1904, by Dr. W. L. Abbott. Original number, 3590.

*Characters*.—A large, dark form of the *Mus surifer* group resembling *M. lingensis*, but color darker and skull with less broadened rostrum; size greater and color not as dark as in *Mus pagensis*.

*Color*.—Ground color dull tawny, darkening slightly on hind legs, and fading on front legs nearly to ochraceous-buff. On back and sides this is nearly concealed by the bristles, which are dark brown at tip, ecru-drab through the greater part of their length. Nape, crown, and face tawny washed with dark brown. Cheeks ochraceous buff. Feet dull white, with no trace of the dark clouding present in *Mus pagensis*. Under parts pale cream-buff. Tail sharply bicolor, dark brown above, whitish below, and at tip.

*Skull and teeth*.—The skull differs from that of *Mus lingensis* in the distinctly less broadened rostrum, in this respect resembling the skull of *Mus surifer*. Otherwise neither it nor the teeth show any special peculiarities.

*Measurements*.—For external measurements see table, page 60. Skull of type: Upper length, 49 mm.; condylobasilar length, 41; basilar length, 38; palatilar length, 19.8; diastema, 12.6; breadth of rostrum midway between base of zygoma and tip of nasals, 7.2;<sup>a</sup> interorbital constriction, 7.6; breadth of braincase above roots of zygomata, 18; mandible, 26.6; maxillary tooth row (alveoli), 7.6; mandibular tooth row (alveoli), 7.

*Specimens examined*.—Twelve, all from Pulo Serutu.

*Remarks*.—Although in a general way resembling the two other dark members of the group, this species is readily distinguishable from *Mus lingensis* by its slender rostrum and from *Mus pagensis* by its less darkened color and its clear white feet. In two of the skins there is a complete collar of dull ochraceous buff, and in three others there is some indication of a similar band.

## MUS CARIMATÆ, new species.

*Type*.—Adult male (skin and skull), No. 125079, United States National Museum. Collected at Telok Pai, Karimata Island, August 20, 1904, by Dr. W. L. Abbott. Original number, 3612.

<sup>a</sup>In two skulls of *Mus lingensis*, female, No. 113040, with basilar length 37 mm., and male, No. 113048, with basilar length 38 mm., their breadth is 8 mm. and 8.4 mm., respectively.

*Characters*.—A small bright-colored member of the *Mus surifer* group, readily distinguishable from *Mus serutus*, but somewhat closely resembling *Mus surifer* of the Malay Peninsula. From this it differs in smaller size, relatively larger teeth, and shorter, wider incisive foramina.

*Color*.—Ground color, between ochraceous and ochraceous-buff, becoming somewhat lighter on cheeks and front legs, slightly darker on hind legs. Back somewhat clouded by the blackish tips of the bristles, but sides almost clear. Under parts and feet buffy white. An ochraceous buff collar in the type, and two other skins.

*Skull and teeth*.—The skull and teeth resemble those of *Mus surifer*, but the average size of the skull is less and that of the teeth greater.

*Measurements*.—For external measurements see table, page 60. Skull of type: Upper length, 43.6 mm.; condylobasilar length, 37; basilar length, 34; palatilar length, 17.8; diastema, 12; breadth of rostrum midway between zygoma and tip of nasals, 7; interorbital constriction, 7; breadth of braincase above roots of zygomata, 16; mandible, 24.4; maxillary tooth row (alveoli), 6.8; mandibular tooth row (alveoli), 6.2.

*Specimens examined*.—Eleven, all from Karimata Island.

*Remarks*.—Though strikingly different from its geographically nearest ally, *Mus serutus*, this species rather closely resembles the mainland member of the group.

*Measurements of Mus from the Karimata Islands.*

| Name and locality.               | Cat. No.            | Sex.          | Total length.    | Head and body. | Tail vertebrae.  | Hind foot. | Hind foot without claws. |
|----------------------------------|---------------------|---------------|------------------|----------------|------------------|------------|--------------------------|
| KARIMATA ISLAND.                 |                     |               |                  |                |                  |            |                          |
| <i>Mus neglectus?</i> .....      | 125114              | Male .....    | mm. 367          | mm. 186        | mm. 181          | mm. 38     | mm. 36.0                 |
| Do.....                          | 125115              | Female.....   | 379              | 184            | 195              | 37         | 35.0                     |
| PULO SERUTU.                     |                     |               |                  |                |                  |            |                          |
| <i>Mus sp. near rattus</i> ..... | 125026              | Female.....   | 384              | 198            | 186              | 39         | 36.8                     |
| Do.....                          | 125027              | Male .....    | 398              | 198            | 200              | 40         | 37.8                     |
| Do.....                          | 125028              | Female.....   | 391              | 190            | 201              | 38         | 35.8                     |
| Do.....                          | 125029              | do .....      | 395              | 190            | 205              | 38         | 35.4                     |
| <i>Mus serutus</i> .....         | 125030              | Male .....    | 432              | 231            | 201              | 46         | 43.6                     |
| Do.....                          | <sup>a</sup> 125032 | do .....      | 404              | 217            | 187              | 46         | 43.4                     |
| Do.....                          | 125039              | do .....      | 377              | 198            | 179              | 45         | 42.4                     |
| Do.....                          | 125042              | do .....      | 420              | 225            | 195              | 47         | 39.0                     |
| Do.....                          | 125043              | do .....      | 395              | 211            | 184              | 44         | 40.0                     |
| Do.....                          | 125033              | Female.....   | 419              | 222            | 197              | 45         | 42.4                     |
| Do.....                          | 125084              | do .....      | 388              | 209            | 179              | 43         | 40.0                     |
| Do.....                          | 125085              | do .....      | 408              | 217            | 186              | 45         | 42.4                     |
| Do.....                          | 125040              | do .....      | 394              | 213            | 181              | 43         | 40.4                     |
| KARIMATA ISLAND.                 |                     |               |                  |                |                  |            |                          |
| <i>Mus carimatae</i> .....       | <sup>a</sup> 125079 | Male .....    | 382              | 201            | 181              | 41         | 39.0                     |
| Do.....                          | 125083              | do .....      | 380              | 197            | 183              | 43         | 40.2                     |
| Do.....                          | 125086              | do .....      | 385              | 201            | 184              | 43         | 40.0                     |
| Do.....                          | 125116              | do .....      | 382              | 211            | 171              | 43         | 40.4                     |
| Do.....                          | 125117              | do .....      | 391              | 202            | 189              | 44         | 41.6                     |
| Do.....                          | 125078              | Female.....   | 418              | 227            | 191              | 41         | 38.6                     |
| Do.....                          | 125080              | Female, young | 358              | 191            | 167              | -----      | -----                    |
| Do.....                          | 125084              | Female.....   | 370              | 196            | 174              | -----      | -----                    |
| Do.....                          | 125085              | do .....      | <sup>b</sup> 302 | 198            | <sup>b</sup> 104 | 40         | 37.6                     |

<sup>a</sup> Type.

<sup>b</sup> Tail imperfect.



## Family VIVERRIDÆ.

## VIVERRA TANGALUNGA Gray.

Three specimens from Karimata Island. They are not as dark as usual. The two adults measure as follows: Adult female, No. 125095, total length 935 mm.; head and body 610; tail 325; hind foot 108; weight 3.17 kg. Adult female, No. 125118, tail 350 mm.; hind foot 105; weight 3.63 kg. The second specimen has two well-developed mammae, both ventral.

## Family TUPAIIDÆ.

## TUPAIA CARIMATÆ, new species

*Type*.—Adult male (skin and skull), No. 125123, United States National Museum. Collected on Karimata Island, September 2, 1904, by Dr. W. L. Abbott. Original number, 3716.

*Characters*.—Like *Tupaia chrysomalla* of the Anambas Islands, but general size less, skull shorter and relatively broader, and teeth much smaller.

*Color*. The color throughout agrees with that of *Tupaia chrysomalla*,<sup>a</sup> though the back averages slightly darker and the ferruginous is perhaps faintly less bright.

*Skull and teeth*. The skull is noticeably smaller than in *Tupaia chrysomalla*, that of full-grown males being exceeded by that of females of the related species. The rostrum is considerably shortened, giving an outline much like that in *Tupaia malaccana*. Teeth like those of *Tupaia chrysomalla*, except that they are smaller throughout, a difference particularly noticeable in the first and second upper molars.

*Measurements*.—Skull of type: Greatest length, 46 mm. (51)<sup>b</sup>, condylobasal length, 42.2 (47.2); basal length, 39 (44.6); palatal length, 23.4 (27.2); least distance from orbit to tip of premaxillary, 18.8 (23); least distance from orbit to posterior point of occiput, 21 (21); diastema, 3.4 (4.4); width of rostrum at middle of diastema, 6.8 (6.4); width of palate including m<sup>2</sup>, 15 (15.8); zygomatic breadth, 24.6 (24.8); interorbital constriction, 13.2 (13.8); breadth of braincase, 18.8 (18.4); mandible, 31 (34.4); maxillary toothrow, exclusive of incisors, 20.2 (24); mandibular toothrow, exclusive of incisors, 16.8 (19.6).

<sup>a</sup> Miller, Proc. Washington Acad. Sci., II, pp. 232-233, August 20, 1900.

<sup>b</sup> Measurements in parenthesis are those of an adult male *Tupaia chrysomalla* from Pulo Jimaja, Anambas Islands (No. 101,743).



*External measurements of Tupia carinata.*

| Locality.                    | Cat. No.            | Sex.           | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot without claws. |
|------------------------------|---------------------|----------------|---------------|----------------|-----------------|------------|--------------------------|
|                              |                     |                | mm.           | mm.            | mm.             | mm.        | mm.                      |
| Karimata Island: Telok Edar. | 125120              | Female adult.. | 320           | 175            | 145             | 40         | 37.0                     |
| Do.....                      | 125121              | .....do.....   | 320           | 175            | 145             | 43         | 40.0                     |
| Do.....                      | 125122              | .....do.....   |               |                |                 | 40         | 37.0                     |
| Do.....                      | <sup>a</sup> 125123 | Male adult ..  | 323           | 176            | 147             | 40         | 37.0                     |
| Karimata Island: Telok Pai.  | 125096              | .....do.....   | 320           | 170            | 150             | 42         | 39.4                     |
| Do.....                      | 125097              | Female adult.. | 305           | 165            | 140             | 40         | 37.4                     |

<sup>a</sup>Type.Family COLUGIDÆ.<sup>a</sup>CYNOCEPHALUS,<sup>a</sup> species.

A young female flying lemur was taken at Telok Edar, Karimata Island, September 3, 1904. While it evidently represents a small form it is too immature to be positively identified.

## Family VESPERTILIONIDÆ.

## PIPISTRELLUS, species.

A single damaged immature specimen (female, No. 125156, U.S.N.M.) taken at Telok Edar, Karimata Island, September 2, 1904, I am unable to determine satisfactorily. Its measurements are: Total length, 77 mm.; tail, 33; tibia, 12; foot, 66; forearm, 30.8; thumb, 5.4; second finger, 26; third finger, 57; fourth finger, 47; fifth finger, 42; ear from meatus, 12.4; ear from crown, 9; width of ear, 7.4.

## MYOTIS CARIMATÆ, new species.

*Type.*—Adult female (in alcohol), No. 125154, United States National Museum. Collected at Telok Edar, Karimata Island, August 28, 1904, by Dr. W. L. Abbott. Original number, 3673.

*Characters.*—Like *Myotis megalopus* (Dobson), but larger and with heavier teeth.

*Ears, membranes, etc.*—The general external characters of the species appear to agree exactly with those of *Myotis megalopus* as described by Dobson and Blanford. They are also in all respects as in a specimen (adult male, No. 112606) collected by Doctor Abbott on the Sembrong River, Johore, July 4, 1901.

*Color.*—After sixteen months immersion in alcohol the fur of the back is a light broccoli-brown with faint grayish reflections, the hairs almost slate black through a little more than basal half. Underparts grayish white tinged with cream-buff on throat, thighs, and base of tail. Chin, blackish. Membranes and ears uniform dark brown.

<sup>a</sup> See Miller, Proc. Biol. Soc. Washington, XIX, p. 41, Feb. 26, 1906.

*Skull and teeth.*—The skull and teeth agree with those of the specimen of *Myotis megalopus* from Johore except for the slightly greater size of the former and the distinctly increased robustness of the latter. Anterior and posterior premolars practically in contact, the second crowded inward from the toothrow and quite invisible from outside. Third upper molar with well-developed metacone and third commissure. Middle lower premolar with area of cross section only about one-third that of first or third.

*Measurements.*—For external measurements see table, page 64. Skull of type: Greatest length, 15.8 mm.; upper length, 13.6; condylo-basilar length, 14; basal length, 11; palatal length, 6; zygomatic breadth, 10; interorbital constriction, 4; breadth of braincase, 7.8; mandible, 11.4; maxillary toothrow, exclusive of incisors, 5.8; mandibular toothrow, exclusive of incisors, 6.2.

*Specimens examined.*—Two, both from the type locality.

### Family EMBALLONURIDÆ.

#### EMBALLONURA ANAMBENSIS Miller.

1900. *Emballonura anambensis* MILLER, Proc. Washington Acad. Sci., II, p. 236. August 20, 1900 (Anambas Islands).

Twenty-six specimens (one skin) were taken at Telok Edar, Karimata Island, August 27 to September 4, 1904. They are readily distinguishable from *Emballonura peninsularis* by the more slender form of the braincase, and from *E. monticola* by their larger size, but I am unable to find any tangible character to separate them from the species occurring in the Anambas and Natunas. For measurements see table, page 64.

### Family MEGADERMIDÆ.

#### MEGADERMA CARIMATÆ, new species.

*Type.*—Adult female (in alcohol), No. 125185, United States National Museum. Collected at Tanjong Karimata Tua, Karimata Island, August 31, 1904, by Dr. W. L. Abbott. Original number, 3709.

*Characters.*—Not as large as *Megaderma spasma* from the Malay Peninsula, but ear distinctly longer, so that its height above crown is noticeably more than half length of forearm.

*Ears, membranes, etc.*—As in *Megaderma spasma*.

*Color.*—The color does not differ appreciably from that of *Megaderma spasma*. In two skins (male, No. 125126, and female, No. 125127) it is a uniform gray throughout, about the gray No. 6 of Ridgway on upper parts, slightly less dark below, the hairs everywhere inconspicuously tipped with ecru-drab.

*Skull and teeth.*—The skull and teeth show no peculiarities except that they are perceptibly smaller than in the related species.

*Measurements.*—For measurement see table, page 64.

*Specimens examined*.—Thirty-one (two skins), all from the type locality.

*Remarks*.—This is a well marked local form, easily recognizable by its reduced general size and lengthened ears. This is best illustrated by the ratio of height of ear above crown to forearm; 47+ in 7 mainland specimens of *Megaderma spasma*, 58+ in 10 of *M. carimatae*.

### Family RHINOLOPHIDÆ.

#### RHINOLOPHUS BORNEENSIS SPADIX (Miller).

1901. *Rhinolophus spadix* MILLER, Proc. Washington Acad. Sci., III, p. 136. March 26, 1901 (South Natunas).

1905. *Rhinolophus borneensis spadix* ANDERSEN, Proc. Zool. Soc., London, 1905, II, p. 87. October 17, 1905 (Karimata and Pulo Serutu).

Three specimens from Pulo Serutu and two from Karimata Island have been identified as above by Mr. Knud Andersen.

#### HIPPOSIDEROS LARVATUS (Horsfield).

Six specimens of a bat provisionally identified as *Hipposideros larvatus* by Mr. Knud Andersen<sup>a</sup> were taken on Pulo Serutu. An adult male (No. 125049) measures, total length, 99 mm.; head and body, 68; tail, 31; tibia, 21; foot, 9; forearm, 54.8; thumb, 9.2; second finger, 44; third finger, 80; fourth finger, 62; ear from meatus, 23.4; ear from crown, 18; width of ear, 19.2.

#### Measurements of bats from the Karimata Islands and Malay Peninsula.

| Name and locality.                  | Cat. No. | Sex.    | Head and body. |       | Tail. | Tibia. | Foot. | Forearm. | Thumb. | Second finger. | Third finger. | Fourth finger. | Fifth finger. | Ear from meatus. | Ear from crown. | Width of ear. | Spread of ears. |
|-------------------------------------|----------|---------|----------------|-------|-------|--------|-------|----------|--------|----------------|---------------|----------------|---------------|------------------|-----------------|---------------|-----------------|
|                                     |          |         | mm             | mm    | mm    | mm     | mm    | mm       | mm     | mm             | mm            | mm             | mm            | mm               | mm              | mm            | mm              |
| KARIMATA ISLAND.                    |          |         |                |       |       |        |       |          |        |                |               |                |               |                  |                 |               |                 |
| <i>Myotis carimatae</i> .....       | 125153   | Female. | 44.0           | 38.4  | 16.0  | 10.0   | 37.2  | 8.8      | 38.0   | 69             | 59            | 53.0           | 15.0          | 12.0             | 10.0            | .....         | .....           |
| Do .....                            | 125154   | do      | 48.0           | 40.0  | 16.8  | 10.4   | 38.6  | 9.0      | 41.0   | 73             | 60            | 55.0           | 16.0          | 12.4             | 10.4            | .....         | .....           |
| <i>Emballonura anambensis</i> ..... | 125140   | Male.   | 44.4           | 14.0  | 17.0  | 8.0    | 45.4  | 7.6      | 36.6   | 75             | 50            | 43.0           | 13.0          | 11.0             | 9.2             | .....         | .....           |
| Do .....                            | 125142   | do      | 43.6           | 13.4  | 16.4  | 6.6    | 45.0  | 8.0      | 37.0   | 71             | 51            | 47.0           | 13.4          | 11.4             | 10.2            | .....         | .....           |
| Do .....                            | 125144   | do      | 47.0           | 10.6  | 15.4  | 6.6    | 44.8  | 7.4      | 37.0   | 73             | 47            | 43.0           | 13.8          | 10.6             | 10.6            | .....         | .....           |
| Do .....                            | 125148   | do      | 45.0           | 13.0  | 17.0  | 7.4    | 46.0  | 8.0      | 36.4   | 72             | 50            | 47.0           | 14.2          | 12.0             | 10.0            | .....         | .....           |
| Do .....                            | 125149   | do      | 44.0           | 14.0  | 16.4  | 7.6    | 44.8  | 8.0      | 35.0   | 69             | 51            | 47.0           | 13.4          | 11.0             | 10.4            | .....         | .....           |
| Do .....                            | 125128   | Female. | 46.0           | 13.8  | 17.0  | 7.2    | 44.4  | 7.6      | 36.0   | 72             | 49            | 46.0           | 12.8          | 11.4             | 10.0            | .....         | .....           |
| Do .....                            | 125130   | do      | 44.0           | 13.0  | 16.4  | 7.6    | 45.0  | 7.4      | 36.0   | 72             | 49            | 46.0           | 14.0          | 11.4             | 10.0            | .....         | .....           |
| Do .....                            | 125131   | do      | 45.0           | 15.0  | 17.2  | 7.0    | 45.0  | 7.4      | 36.0   | 74             | 52            | 48.4           | 14.6          | 12.8             | 10.4            | .....         | .....           |
| Do .....                            | 125132   | do      | 46.0           | 13.4  | 18.0  | 7.0    | 46.4  | 7.0      | 39.0   | 76             | 53            | 50.0           | 14.0          | 12.0             | 9.6             | .....         | .....           |
| Do .....                            | 125137   | do      | 44.4           | 15.0  | 16.0  | 7.0    | 45.4  | 8.0      | 37.0   | 73             | 52            | 48.0           | 15.8          | 12.8             | 11.0            | .....         | .....           |
| <i>Megaderma carimatae</i> ..       | 125165   | Male.   | 69.0           | 2.0   | 32.0  | 16.8   | 56.8  | 17.0     | 50.0   | 100            | 78            | 83.0           | 39.0          | 33.4             | 27.0            | 63.0          | .....           |
| Do .....                            | 125167   | do      | 65.0           | ..... | 31.4  | 15.0   | 58.4  | 18.0     | 52.0   | 103            | 81            | 83.0           | 40.0          | 33.0             | 27.0            | 62.0          | .....           |
| Do .....                            | 125169   | do      | 66.0           | ..... | 31.0  | 15.6   | 56.0  | 17.0     | 48.0   | 105            | 79            | 81.0           | 40.0          | 32.4             | 26.0            | 62.4          | .....           |
| Do .....                            | 125170   | do      | 61.0           | 3.6   | 28.8  | 14.4   | 53.6  | 16.8     | 44.0   | 98             | 72            | 75.0           | 41.0          | 34.0             | 26.0            | 61.0          | .....           |
| Do .....                            | 125171   | do      | 65.0           | 2.1   | 31.0  | 14.0   | 56.0  | 14.8     | 51.0   | 102            | 77            | 80.0           | 40.0          | 31.6             | 26.0            | 61.0          | .....           |
| Do .....                            | 125177   | Female. | 63.0           | ..... | 31.8  | 13.8   | 58.0  | 16.2     | 49.0   | 106            | 80            | 84.0           | 38.0          | 31.4             | 26.0            | 62.4          | .....           |
| Do .....                            | 125179   | do      | 67.0           | ..... | 31.0  | 14.6   | 54.4  | 15.2     | 48.0   | 104            | 78            | 83.0           | 39.0          | 31.6             | 26.4            | 62.0          | .....           |
| Do .....                            | 125183   | do      | 72.6           | ..... | 32.0  | 16.0   | 56.0  | 17.0     | 48.0   | 103            | 79            | 85.0           | 39.4          | 33.6             | 27.0            | 64.0          | .....           |
| Do .....                            | 125184   | do      | 63.0           | ..... | 32.0  | 17.0   | 55.0  | 17.4     | 51.0   | 108            | 81            | 84.0           | 42.4          | 35.0             | 27.0            | 65.0          | .....           |
| Do .....                            | 125187   | do      | 67.0           | ..... | 4.0   | 33.4   | 16.4  | 58.6     | 18.0   | 111            | 81            | 83.0           | 42.4          | 35.0             | 29.0            | 66.0          | .....           |

<sup>a</sup> Type.

<sup>a</sup> Under date of January 17, 1906, Mr. Andersen writes: "I do not think I shall have to separate these from *Hipposideros larvatus*."

## Measurements of bats from the Karimata Islands and Malay Peninsula—Continued.

| Name and locality.           | Cat. No. | Sex.         | Head and body. |       | Tail. | Tibia. | Foot. | Forearm. | Thumb. | Second finger. | Third finger. | Fourth finger. | Fifth finger. | Ear from meatus. | Ear from crown. | Width of ear. | Spread of ears. |
|------------------------------|----------|--------------|----------------|-------|-------|--------|-------|----------|--------|----------------|---------------|----------------|---------------|------------------|-----------------|---------------|-----------------|
| JOHORE: TANJONG SIKAKAP.     |          |              | mm.            | mm.   | mm.   | mm.    | mm.   | mm.      | mm.    | mm.            | mm.           | mm.            | mm.           | mm.              | mm.             | mm.           | mm.             |
| <i>Megaderma spasma</i> .... | 112737   | Female.      | 61.0           | ..... | ..... | 16.0   | 59.0  | 17.0     | 53.0   | 114            | 81            | 85.0           | 32.0          | 29.0             | 24.0            | 55.0          |                 |
| Do .....                     | 112738   | .....do..... | 64.0           | ..... | 35.0  | 17.6   | 61.0  | 18.8     | 56.0   | 116            | 84            | 88.0           | 37.0          | 29.0             | 24.0            | 58.0          |                 |
| Do .....                     | 112739   | .....do..... | 66.0           | 1.4   | 35.0  | 15.0   | 60.0  | 17.4     | 53.0   | 112            | 84            | 87.0           | 36.0          | 27.0             | 24.0            | 56.0          |                 |
| Do .....                     | 112740   | .....do..... | 66.6           | ..... | 32.0  | 15.0   | 57.0  | 18.6     | 53.0   | 109            | 85            | 89.0           | 36.0          | 27.4             | 24.0            | 57.0          |                 |
| Do .....                     | 112741   | .....do..... | 66.0           | ..... | 35.0  | 16.0   | 59.0  | 16.4     | 52.0   | 114            | 88            | 86.0           | 35.0          | 28.0             | 26.0            | 57.0          |                 |
| Do .....                     | 112742   | .....do..... | 61.4           | ..... | 32.0  | 15.4   | 59.0  | 16.4     | 55.0   | 112            | 82            | 89.0           | 35.4          | 28.0             | 25.0            | 56.4          |                 |
| Do .....                     | 112743   | .....do..... | 72.0           | ..... | 34.0  | 16.0   | 57.0  | 18.0     | 55.0   | 113            | 88            | 87.0           | 37.0          | 29.0             | 25.0            | 58.0          |                 |

## MACACA FASCICULARIS (Raffles).

Two specimens (male, No. 125101, and male, No. 125102) were taken at Telok Pai, Karimata Island. They appear to represent a small form with color not as bright as in the Sumatran animal, but the material is not sufficient to show their status satisfactorily.

## PRESBYTIS CARIMATÆ, new species.

*Type*.—Adult female (skin and skull), No. 125158, United States National Museum. Collected at Telok Edar, Karimata Island, August 21, 1904, by Dr. W. L. Abbott. Original number, 3627.

*Characters*.—Similar to *Presbytis rubicundus*, but color lighter and brighter. Skull and teeth like those of the Bornean species, except that the pterygoid fossa is not as deep and the mandible is more robust.

*Color*.—Type: General color throughout a red, intermediate between the hazel and rufous of Ridgway (though somewhat nearer the former), fading almost to tawny on crown and on inner surface of legs, darkening slightly on outer surface of legs, and becoming nearly chestnut on hands and feet. Tail concolor with back. Under parts faintly lighter. Some of the other skins are not as bright, but none closely approaches the dull hazel of *Presbytis rubicunda*.

*Skull and teeth*.—In general the skull and teeth are as in the Bornean species, but the mandible is more heavily built, particularly behind the toothrows, its articular condyle is broader and more squarish in outline, and the pterygoid fossæ are broader and not as deep. In *Presbytis rubicunda* these cavities extend noticeably below level of basisphenoid (skull held upside down), while in the Karimatan animal they terminate more nearly opposite its surface.

*Measurements*.—For external measurements see table. Skull of type: Greatest length, 95 mm.; condylobasilar length, 69; basilar length, 62.4; palatilar length, 25; zygomatic breadth, 72; constriction behind orbits, 43.6; interorbital breadth, 8; breadth of braincase, 56;



mandible, 68; maxillary toothrow, exclusive of incisors, 30.4; mandibular toothrow, exclusive of incisors, 34.4

*Specimens examined*.—Seven, all from Karimata Island.

*Measurements Presbytis carinata and Macaca fascicularis.*

| Name and locality.               | Cat. No. | Sex.         | Head and body. | Tail vertebrae. | Hind foot. | Weight. |
|----------------------------------|----------|--------------|----------------|-----------------|------------|---------|
| KARIMATA ISLAND.                 |          |              |                |                 |            |         |
| <i>Presbytis carinata</i> .....  | 125103   | Male .....   | mm. 520        | mm. 670         | mm. 175    | kg. 7.0 |
| Do .....                         | 125104   | Female.....  | 525            | b 590           | 170        | 6.6     |
| Do .....                         | 125105   | ....do ..... | 460            | 700             | -----      | 6.6     |
| Do .....                         | 125106   | ....do ..... | 535            | 715             | 168        | 7.2     |
| Do .....                         | 125157   | ....do ..... | 530            | 710             | 169        | 7.5     |
| Do .....                         | a 125158 | ....do ..... | 505            | 730             | 174        | 6.5     |
| Do .....                         | 125159   | ....do ..... | 528            | 745             | 171        | 7.2     |
| <i>Macaca fascicularis</i> ..... | 125101   | Male .....   | 460            | 655             | 144        | 5.4     |
| Do .....                         | 125102   | ....do ..... | 460            | 630             | 145        | 5.3     |

a Type.

b Tail imperfect.

NOTES ON A COLLECTION OF FISHES FROM ARGENTINA,  
SOUTH AMERICA, WITH DESCRIPTIONS OF THREE NEW  
SPECIES.

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By BARTON WARREN EVERMANN  
and  
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*Of the U. S. Bureau of Fisheries.*

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This paper is based on a collection of fishes made in Argentina by Mr. John W. Titcomb,<sup>a</sup> in 1903 and 1904, while engaged in inaugurating fish-cultural operations for the Argentine Government. The collection contains 52 species, of which about half are from fresh water. The marine species are from Mar del Plata or the market at Buenos Aires. The latter are mostly from Uruguayan fisheries. The freshwater species are from Rio Primero in the Province of Cordoba, and from the headwaters of the Rio Negro, chiefly Lakes Nahuel Huapi and Traful and tributary or neighboring waters. Unfortunately when received some of the labels had become partly effaced, making some of the localities uncertain.

Mr. Titcomb has kindly furnished us the following interesting information regarding the lakes and streams of Argentina:

In general, leaving out the larger rivers, the fresh waters of Argentina may be divided into three classes:

First, the cold clear waters of the Cordilleras and rivers having their sources in the Andes from the Limay south.

Second, clear-water streams constantly flowing and not having an excessively high temperature in summer; clear-water ponds supplied with water from such streams and having a constant inflow and outflow. The streams flowing south from the Sierras in the Province of Buenos Aires are examples of the streams above described, and in the same region Lago de Bravo and Lago de los Padres are examples of the ponds coming under this head. In the northern provinces the Rio Primero and the Dique San Roque belong to the same class of waters. All of them are practically unproductive, containing only small fishes.

Third, streams which are sluggish and more or less muddy, and which have an excessively high temperature in summer; ponds and lakes which are natural basins

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<sup>a</sup>See Boletin del Ministerio de Agricultura, No. 3, I, May, 1904, pp. 253-278.

for catching surface water, which never go dry, and which have no regular supply or discharge of water. Lake Nahuel Huapi is the largest of a chain of lakes in the Andes Mountains, which may be called the sources of the Rio Limay. These are found in latitude  $38\frac{1}{2}^{\circ}$  to  $41\frac{1}{2}^{\circ}$  south. Lake Nahuel Huapi is almost on the Chilean border, the dividing line being a series of steeply-shaped peaks which are snow-clad throughout the year. Its elevation is about 2,500 feet. The waters are very clear and one can see to a depth of about 20 or 30 feet. The shore line is very irregular, and only a very small part of the lake can be seen at any one time by a boatman on it. There are several islands in the lake one of which contains a small pond of about 15 or 20 acres in area. The lake is fed by innumerable small streams, and several quite large ones. Lake Trafal is about 2,300 feet elevation, and is much smaller than Lake Nahuel Huapi. It covers perhaps one-tenth of the area of the larger lake. It is probably about 10 miles long and 2 miles wide at its widest point. It is surrounded by mountains, and the shore line is precipitous, so much so that in many places it is impossible to make a landing from the lake. This lake is apparently very deep, and its waters are clear and cold, similar to those of Lake Nahuel Huapi. Various other lakes in the same district mentioned above were reported to be similar in character. Some of them are larger than Lake Trafal. Lake Nahuel Huapi reminds one very much of Lake Winnepesaukee. It is quite as irregular, has clearer water of a lower temperature, and not nearly so many islands. It must be very deep in some parts. The shores rise abruptly several hundred feet in places.

The nature of the waters of the Limay River may be judged pretty accurately from the description of Lakes Nahuel Huapi and Trafal. These and many other lakes in the Andes flowing into the river cause it at times to overflow its banks and spread over quite a large territory. At the outlet of Nahuel Huapi, which may properly be called the source of the Limay, the lake itself rises 15 or 20 feet. When the river is at its normal height it is in places only 200 or 300 yards wide, but quite deep. In other places it is a mile wide. In many places there are rapids dangerous to navigation in small boats. Owing to the fact that the river spreads out in width so frequently, and also because it breaks up in small channels, it can not be called navigable for any but small boats.

We are indebted to Dr. Carl H. Eigenmann, of Indiana University, for assistance in the identification of the Characins.

### Family GALEIDÆ.

#### 1. *MUSTELUS CANIS* (Mitchill).

##### TIBURÓN; CAZÓN.

*Squalus canis* MITCHILL, Trans. Lit. and Philos. Soc. New York, I, 1815, p. 486, New York.

*Mustelus vulgaris*, GÜNTHER, Ann. Mag. Nat. Hist., 5th ser., No. 3, July, 1880, p. 7.

*Galeus canis*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 7 (Bahia Blanca; Mar del Plata; Montevideo; Río de la Plata).

Berg says that this species is rather common on the coast and ascends the Río de la Plata almost to fresh water.

We have 4 specimens, all males, measuring from 17.25 to 22.75 inches total length.

## Family SQUATINIDÆ.

## 2. SQUATINA SQUATINA (Linnæus),

## ANGEL.

*Squalus squatina* LINNÆUS, Syst. Nat., 10th ed., 1858, p. 233, Europe.

*Rhina squatina*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 608 (Mar del Plata).

*Squatina squatina*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 9 (Bahia Blanca; Mar del Plata; Montevideo).

Berg says this species occurs in considerable abundance at Bahia Blanca, Mar del Plata, Montevideo, and along the whole south coast.

Our collection contains one specimen 20 inches long from the market at Buenos Aires, probably from Uruguayan fisheries.

## Family NARCOBATIDÆ.

## 3. DISCOPYGE TSCHUDII Heckel.

## RAYA ELECTRICA.

*Discopyge tschudii* HECKEL in Tschudi, Untersuch. Fauna Peruviana, 1845, p. 33, pl. VI, Peru.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 10 (Mar del Plata).

Two specimens 16 and 12.5 inches in total length, respectively, from the market of Buenos Aires, agree very well with Berg's description.

## Family RAJIDÆ.

## 4. RAJA PLATANA Günther.

## RAYA.

*Raja platana* GÜNTHER, Challenger Rept., Zool., I, 1880, p. 11, pl. III, Rio de la Plata, in 13 fathoms.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 13 (Mar del Plata; Montevideo; Rio de la Plata).

Berg states that this species is comparatively more abundant than the others and reaches a larger size. He has seen individuals a meter in diameter. He says that they have the antero-lateral border somewhat sinuous rather than straight, as figured by Günther.

We identify the single specimen in our collection with this species, although it differs somewhat from Günther's description and figure.

Total length 23.5 inches; length of disk about 2 in total length; eye 8.63 in snout, 2.36 in interorbital; teeth short, bluntly conic in front, nearly flat at ends of jaws, 40 rows in the upper jaw, 44 in the lower. Body smooth above, excepting a patch of scattering prickles about halfway between eye and lateral border; a group of small spines on snout; scattering prickles in front of and between eyes; a short spine before each eye and 2 behind, near inner end of each spiracle; 3 short spines and a few prickles on back near junction with head; scattering prickles along back and front of and between ventral



fins and on base of tail; an interrupted series of spines along median dorsal aspect of tail; 1 spine between dorsals; below smooth, excepting a moderately broad patch of fine prickles on antero-lateral border in region anterior to nostrils and on each side of snout; snout smooth.

Color in alcohol, above light brown with large faint dark-brown spots, giving it a coarsely mottled appearance; a large ocellus at middle base of each pectoral, the center dark brown, surrounded by gray; traces of dark brown cross-bars on tail; each side of snout with pale area, probably hyaline in life; below entirely white, excepting a long triangular dark-brown spot on the snout, its apex toward mouth; symmetrically arranged bluish pores, thick anteriorly, becoming fewer and disappearing on abdomen.

##### 5. *RAJA MICROPS* Günther.

*Raja microps* GÜNTHER, Challenger Rept., Zool., I, 1880, p. 11, pl. iv, mouth of Rio de la Plata.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 14 (Mar del Plata; Rio de la Plata).

Concerning this species, Berg says that it occurs with less frequency than the former species [*R. agassizi* and *R. platana*] from which it is distinguished principally by the much shorter snout; and usually there are 34 series of pavement teeth.

The only example in our collection is a female from Buenos Aires market. We have identified it with this species, although it does not agree in every way with Günther's description and figure. There is no trace of the conspicuous fan-shaped patches of muciferous tubes just posterior to the head, mentioned and figured by Günther.

The following notes are taken from our specimen: Total length 20.87 inches; length of disk about 2.31 in total length; width of disk about 1.51; snout about 3.34 in length of disk; interorbital space about 3.11 in snout. Teeth flat, 42 series in upper jaw and 30 in the lower; snout short, its angle greater than a right one; anterior margin of pectoral slightly sinuous from snout to the rounded outer margin.

Ventrals deeply emarginate, with crenate edges; tail flat, with a narrow fold on each side; series of spines along the back and tail to the first dorsal, and one spine between the fins; a spine behind each eye and opposite the spiracles; a spine in front of the upper margin of each eye and one on each side of the body opposite the spiracle and in line with the anterior margin of pectoral fin; a broad patch of prickles along anterior margin of pectoral, diminishing in width to the snout; space between the eyes prickly; a line of prickles along each side of median line of spines of the back, also along each side of base of tail for a short distance beyond base of ventrals; a narrow strip of prickles on each side of lower part of snout. Color olivaceous gray, with faint traces of darker spots.

## 6. PSAMMOBATIS SCOBINA (Philippi).

## RAYA.

*Raya scobina* PHILIPPI, Weig. Archiv für Naturg., XXIII, 1857, p. 270, Chile.

*Psammobatis rudis* GÜNTHER, Cat., VIII, 1870, p. 470, Sandy Point, Chile.—BERG,

Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 14 (Mar. del Plata).

*Raja scobina* PHILIPPI, Anal. Mus. Nac. Chile, Zool., 1892, p. 2, pl. 1, fig. 1 (Chile).

Berg records *Psammobatis rudis* Günther, in the synonymy of which he doubtfully includes *Raja scobina* Philippi. Regarding it he says: "This species, which, according to Günther, is identical with *Raya scobina* Philippi of the Pacific coast of Chile, is comparatively rare. The longest of those examined was 28 cm. The number, form, and distribution of the spines and sharp tubercles, as well as the coloration and the extent of the pale spots, vary greatly in this ray."

Günther's type of his species, *Psammobatis rudis*, was an immature individual only 7 or 8 inches long, some of the characteristics of which were the perfectly circular disk; snout short, overlapped by the anterior portions of the pectoral fins; tail with no distinct terminal fin, and each ventral divided into two by a deep notch.

In the *Challenger* report he presents additional notes on the species and gives some figures, stating that a male example 11.5 inches long was still far from mature; the disk not circular, but the anterior margins more rectilinear; a thin rostral appendage present; the tail showing a distinct terminal fin. His figures show the ventral fin divided almost into two. In this report Günther doubtfully includes Philippi's *Raja scobina* in the synonymy of *Psammobatis rudis*.

In the *Anales del Museo Nacional de Chile*, 1892, in which he re-describes and figures *Raja scobina*, Philippi says of a specimen 27 cm. in length, that the disk is circular; but he italicizes the statement that the ventrals are situated wholly behind the vent, their margins rounded and not divided into two lobes. We have no way of definitely deciding whether these two forms are specifically identical; but we have one specimen which seems to be closely related to them, yet not fully agreeing with the description of either. Inasmuch as it agrees with one about as well as with the other and as *R. scobina* is the older name and regarded by Günther as probably synonymous with *P. rudis*, we adopt it as the name for our specimen which we provisionally identify as a *Psammobatis*.

Following is a brief description of our specimen: Total length 23.5 inches; width 17 inches; disk with nearly rectilinear margins forward, its width greater than its length, measured from tip of snout to posterior base of pectoral fin; a short filamentous rostral projection; eye 8.63 in snout, 2.36 in interorbital; teeth short, bluntly conic in front, nearly flat at end of jaws, 40 rows in the upper jaw and 44 in the lower; ventrals not wholly behind vent, deeply notched but not divided into two distinct lobes; on about the middle of the back 3 short bluntish

spines, behind which are traces of other spines; broad patch of prickles along anterior margin of pectoral nearly to snout where the patch becomes narrower and the prickles more scattering; scattering minute prickles between and in front of eyes, and on back arranged in 3 or 4 rows extending from spines about middle of back on tail to about opposite tip of ventral; tail depressed with fold along each side and a single row of stout spines along the median dorsal line from between ventrals to first dorsal and one spine between dorsals; no spines on side of tail; dorsal fins each with a cartilaginous support or ray similar to that in *Sympterygia*, not present in the other skates.

7. *SYMPTERYGIA BONAPARTII* Müller and Henle.

BAYA.

*Sympterygia bonapartii* MÜLLER and HENLE, Wieg. Archiv für Naturg., III, Pt. 1, p. 155, pl. XLIX.

*Sympterygia bonapartei*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 15 (Mar del Plata; Montevideo; Rio de la Plata).

*Sympterygia acuta* GARMAN, Proc. Bost. Soc. Nat. Hist., XIX, 1877, p. 206, Buenos Aires.

Recorded by Berg from Mar del Plata, Montevideo and Rio de la Plata. He observes that this species of ray, which is very common in the localities mentioned and whose country was known neither to Müller and Henle, nor to Günther, is very variable in respect to the prolongation of the snout, the width of the fins, the length of the tail, and the shape of the antero-lateral border. This last in one example is rectilinear, in other instances curved, and in others, principally the males, sinuous. The males usually have various series of dorso-lateral spines.

In the identification of our specimens of this genus we follow Berg, although the characters of the type, a female in the Berlin Museum, as shown in the brief description and the figure by Müller and Henle, are widely different from those of our specimens. But Berg found much variation in the species, and includes Garman's *S. acuta* from Buenos Aires (the description of which agrees fairly well with our specimens) as being conspecific with his specimens. Besides, the type of *S. bonapartii* seems to be *sine patria*, although it is not impossible that it came from South America. Müller and Henle say that the thin teeth are flat, while Garman says: "Teeth small, subquadrangular on the base, sharp in the middle series, blunter to flat toward the angles of the mouth, in 42 series on the upper jaw and 40 below."

The following are descriptions of 2 of the specimens in our collection:

Description of male: Length of disk slightly over 2 in total length; width of disk 1.75; eye small, 4.5 in interorbital; snout long and sharp, about 2.35 in length of disk; interorbital 3.77 in snout, wider than the distance of eye and spiracle taken together.

Teeth in 47 series above and 45 below: in upper jaw 7 rows at each end are flat, the rest sharp; 9 rows at each end of lower jaw are flat, the remainder sharp; all the sharp teeth hooked inward: margin nearly straight from tip of snout to about opposite anterior margin of eye, then abruptly curving outward as the anterior margin of the pectoral: pectoral rounded, the exertion of the rays giving it a crenulate margin and for the same cause the ventrals being crenate: dorsal moderately high, the second deeply notched near the tip of the tail, each with a thick cartilaginous ray: a series of strong spines from the middle of back to first dorsal and one spine between the dorsals: no other large spines: about 4 rows of small hooked spines near the edge on the widest part of each pectoral: whole anterior margin of pectoral nearly to tip of snout with a broad band of prickles: a band of small prickles from base of snout on the translucent area, between the eyes and whole length of back nearly to tip of tail. Color in spirits, brownish above with streaks and cloudy effects of darker, as if soiled.

Description of female: Length of disk 2 in total length; width of disk about 1.81; snout about 2.27 in length of disk; interorbital about 4.35 in snout; eye 3.85 in interorbital; teeth 42 rows in each jaw; about 6 rows in the upper jaw and 8 in the lower at each end are flat; the remainder pointed on an expanded base.

Body of same general shape, and spines arranged about the same as in the male. Below there is a dense patch of prickles over the whole area between the rows of gill-openings: a large irregularly arranged patch on each pectoral base opposite and posterior to gill-openings: anterior concave margins of pectorals prickly, as in male, and others about the same.

This description from a male 20.12 inches long and a female 21 inches long, both from Buenos Aires. A third female 22 inches long has the teeth in 48 rows in upper jaw and 50 in the lower.

### Family CALLORHYNCHIDÆ.

#### 8. CALLORHYNCHUS CALLORYNCHUS (Linnæus).

GALLO.

*Chimæra callorhynchus* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 236, "Habitat in Mari Æthiopico."

*Callorhynchus callorhynchus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 18 (Santa Cruz; Mar del Plata; Montevideo; Rio de la Plata).

Berg says that this species is not rare in the waters of the Atlantic coast from Bahia de Santa Cruz to Montevideo: the usual length 70 to 80 cm., but individuals of 1 m. are very rare.

We have one specimen something over 77 cm. (30.5 inches) total length.



## Family CLUPEIDÆ.

9. *SARDINELLA ARCUATA* (Jenyns).

*Clupea arcuata* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 134, Bahia Blanca.—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890–91, p. 655 ("Canale della Beagle").—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 19 (Bahia de Santa Cruz; Bahia Blanca).

Three specimens in our collection furnish the figures for the following table:

*Proportional measurements of Sardinella arcuata.*

| Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout in head. | Ventral scutes. | D. | A. | Pectoral in head. |
|-------------------------|--------------------------------|--------|--------------|----------------|-----------------|----|----|-------------------|
| 3.75                    | 5                              | 4      | 3.20         | 4              | 18+10           | 14 | 19 | 1.33              |
| 3.87                    | 5.38                           | 4.11   | 3.25         | 4.33           | 18+10           | 14 | 22 | 1.44              |
| ?                       | 5.04                           | 3.88   | 3            | 3.85           | 19+9            | 14 | 21 | 1.22              |

Mouth very oblique; upper outline nearly straight from tip of snout to caudal; ventral outline strongly curved from tip of lower jaw; dorsal origin about halfway between tip of snout and upper base of caudal; ventral insertion in advance of origin of dorsal.

Color in alcohol, thickly punctated with dusky on back, giving it a bluish-gray appearance; lower parts silvery; middle caudal rays dusky; all other fins pale; tip of lower jaw black; tip of snout with black punctulations.

10. *BREVOORTIA TYRANNUS* (Latrobe).

## LACHA.

*Clupea tyrannus* LATROBE, Trans. Amer. Philos. Soc. Phila., V, 1802, p. 77, Chesapeake Bay.

*Clupanodon aureus* AGASSIZ in Spix, Pisc. Brasil., 1829, p. 52, pl. XIX, "Habitat Bahiæ et alibi in ora Brasilie orientale."

*Alosa pectinata* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, p. 135, pl. xxv, 1842, Bahia Blanca.

*Clupea aurea*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890–91, p. 655 (La Plata e Belgrano).

*Clupea pectinata*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 17 (Bahia Blanca; Mar del Plata; Montevideo; Embocadura del Rio de la Plata).

*Brevoortia tyrannus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 20 (Mar del Plata; Montevideo; Rio de la Plata.)

Berg records "*Brevoortia tyrannus*" from Montevideo and Rio de la Plata, where he says it sometimes occurs in great abundance, ascending the Rio de la Plata as far as Belgrano. He also lists "*Clupea pectinata* (Jen.)" from Bahia Blanca, Mar del Plata, Montevideo, and Embocadura del Rio de la Plata, saying that it abounds during the winter, but apparently does not ascend the Rio de la Plata beyond salt water.



Jenyns' *Clupea pectinata* is a *Brevoortia* and was regarded by Goode<sup>a</sup> as a distinct species, taking the place of *B. tyrannus aurea* south of Brazil, from which it was distinguished chiefly by the fewer scales in a transverse series, the formula for which was in 3 specimens 50, -18 to 20. One of these specimens was from Rio Grande, Brazil. Goode did not give the scale formula for *aurea*, but in his figure, Plate III, fig. 3, there are over 60 laterally and 23 or 24 transversely. There are, however, just as many scales in one figure of a menhaden from Woods Hole. Goode had a large number of northern menhaden in which he found great variation in the proportional measurements; in fact, in all their characters, sufficient indeed to cause him to regard local groups as varieties.

He had comparatively few Brazilian specimens, and only 3 which he regarded as *B. pectinata*. It is probable that if he had had more of the latter he would have found as great variation in them as he did in the northern fish. We have examined a small series of northern menhaden, but none of *aurea* and but 1 of *pectinata* which is Goode's Paraguayan example. We are therefore not in a position to reach any positive conclusion regarding the identity or distinctness of these forms. We have, however, 2 specimens in the present collection which in the number of scales agrees with *B. pectinata*, but compared with the above-mentioned Paraguayan example of that species, is as different in other respects as are specimens from Chesapeake Bay. The most notable difference is in the position of the ventrals and the consequent difference in the extent of the pectorals. In northern menhaden Goode states this character is variable and unreliable. Our specimens, compared with 2 Chesapeake Bay specimens of somewhat smaller size, are very different. They have deeper heads, fewer longitudinal scales, and a more posterior situation of the ventrals. With all these difficulties before us we deem it inadvisable to attempt to draw any conclusions further than that intergradation probably exists and that *B. pectinata* is not more than a subspecies at most; and that an examination of a larger series of menhaden from the habitat of this form would reveal that it is the only menhaden there, but subject to great variation as in the north. Being unable more closely to identify our specimens with *B. pectinata* than with *aurea* or *tyrannus* we provisionally designate them as *Brevoortia tyrannus*, in as much as Berg records this species from those waters.

The tails being somewhat broken we have to give their lengths to base of caudal only. Lengths 12.27 and 11.57 inches, respectively; head 3.37 and 3.35 in length; depth 2.76 and 3.01; eye 7.75 and 7.33 in head; snout 4.04 and 4.40; maxillary 2.11 and 2.39; mandible 1.72; scales about 50-15 (vertical); D. 14 ? and 17; A. 21 and 20.

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<sup>a</sup> Rept. U. S. Fish Comm., V, 1877 (1879), pp. 18, 30.

## Family ENGRAULIDÆ.

## 11. LYCENGRAULIS GROSSIDENS (Cuvier).

## SARDINA.

*Engraulis grossidens* CUVIER in Spix (Agassiz) Pisc. Brasil., p. 50, pl. xxiv, fig. 1, 1829.—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 654 (Montevideo).

*Lycengraulis grossidens*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 21 (Mar. del Plata; Montevideo).

Concerning this species Berg states that it sometimes reaches the markets of Buenos Aires and Montevideo in considerable abundance.

We have the bones of the lower part of the head, a part of the vertebral column, and the stomach of an individual found in the stomach of *Acanthistius patachonicus*.

The teeth sufficiently indicate the genus, but it is impossible to determine the species with certainty.

The stomach was distended with fragments of minute crustaceans.

## Family LEPTOCEPHALIDÆ.

## 12. LEPTOCEPHALUS ORBIGNYANUS (Valenciennes).

*Conger orbignyanus* VALENCIENNES in D'Orbigny, Voy. L'Amér. Merid., V, 1847; Poiss., p. 10; Atlas, pl. xii, fig. 1.

? *Conger multidens* CASTELNAU, Anim. nouv. l'expédition L'Amér. du Sud, Poiss., 1855, p. 84, pl. XLIV, fig. 1, "De Rio de Janeiro".

*Conger vulgaris*, GÜNTHER, in part, Cat., VIII, 1870, p. 38 (South America).—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 656 (Montevideo).—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 23 (Mar del Plata; Montevideo).

*Conger conger* LINNÆUS (= *C. orbignyanus*, VALENCIENNES ?).—GÜNTHER, Ann. Mag. Nat. Hist., 5th ser., 3, July, 1880, p. 13 (La Plata).

? *Leptocephalus multidens*, JORDAN and DAVIS, Rept. U. S. Fish Comm., XVI, 1888 (1892), p. 664 (coast of Brazil).

*Leptocephalus conger*, JORDAN and DAVIS, Rept. U. S. Fish Comm., XVI, 1888 (1892), p. 664.

The most prominent character used by Günther and by Jordan and Davis to distinguish the species of conger eels is the position of the origin of the dorsal fin with reference to the tip of the pectoral.

Günther<sup>a</sup> definitely recognizes 4 species, *Conger marginatus*, *C. vulgaris*, *C. multidens*, and *C. macrops*, of which *C. vulgaris* and *C. multidens* are represented from South America.

In a footnote Günther says of *Conger orbignyanus*, that it is probably identical with one of the species described; that D'Orbigny represents the origin of the dorsal as being a short distance behind the extremity of the pectoral fin, while this distance is increased to the entire length of the latter fin in Doctor Kaup's description.

<sup>a</sup>Cat., VIII, 1870.

Regarding the position of the dorsal in *C. vulgaris*, Günther states that it begins opposite or nearly opposite the extremity of the pectoral; that in *C. multidentis* it begins the length of the pectoral behind the extremity of that fin.

Jordan and Davis recognize 3 species of *Leptocephalus* in America and Europe—*L. multidentis*, *L. conger*, and *L. caudilimbatus*. The only stated distinguishing character of *L. multidentis* is the position of the front of the dorsal, which is the length of the pectoral behind the extremity of that fin; *L. conger* has the position of the dorsal origin opposite or just behind tip of pectoral, and *L. caudilimbatus* above middle of pectoral.

We have 3 specimens of *Leptocephalus* which we have compared with other specimens from North and South America. North Atlantic examples seem to have the dorsal more advanced than those from the south Atlantic, but we do not regard the position of the dorsal as of much diagnostic importance. The figure of Valenciennes's *C. orbignyanus* represents the origin of the dorsal about 0.40 the length of the pectoral from its tip. In Castelnau's figure of *C. multidentis* the dorsal origin is about the length of pectoral posterior to its tip.

In our specimens the dorsal origin ranges from about 0.40 of the pectoral to nearly its whole length behind the tip of the latter fin.

While this character is of little value, there are others exhibited by our specimens which indicate that they are distinct from North American and at least north European congers. Valenciennes gives but a brief note regarding *C. orbignyanus*, stating it is remarkable for its length of snout and the development of the lips, and that there is only a little patch of teeth on the head of the vomer.

Aside from the more posterior situation of the dorsal, Castelnau's description and figure show only a somewhat larger eye to distinguish it from *C. orbignyanus*. The proportionally larger eye may be due to the smaller size of the specimen. Our 3 specimens seem to be much more slender than north Atlantic examples, and appear to differ also in that respect from figures of north European congers. They present also other distinguishing characters, the most prominent of which are the proportionally shorter head, smaller eye, and somewhat larger mouth. In view of the foregoing facts, while from lack of material we do not feel justified in uniting *L. orbignyanus* and *L. multidentis*, we believe that an examination of more material would result in that disposition of them. We do, however, believe that the differences shown in our specimens from *L. conger* justify the adoption for them of the oldest available name, which seems to be *L. orbignyanus* Valenciennes. Berg records the present species as *Leptocephalus conger*, regarding which he says, "It is found rather frequently, but in limited numbers. Examples of this species present great variation in respect to the coloration of the upper half of the body; some are of a

pale gray, others bluish or brownish gray or wholly brown or black; the lower part is whitish or pale or dull ashy; the fins are uniform in coloration or bordered with black."

*Proportional measurements of North American specimens of L. conger and of L. orbignyanus.*

| Name.                       | Total length in inches. | Head in total length. | Eye in snout. | Eye in inter-orbital. | Snout in head. | Extent of gape.         |
|-----------------------------|-------------------------|-----------------------|---------------|-----------------------|----------------|-------------------------|
| <i>L. conger</i> .....      | 25                      | 6.06                  | 2             | 1.29                  | 3.88           | To 0.75 of eye.         |
| <i>L. conger</i> .....      | 22.12                   | 6                     | 2.4           | 1.21                  | 2.76           | To 0.85 of eye.         |
| <i>L. conger</i> .....      | 17.12                   | 5.95                  | 1.57          | 1                     | 3.06           | To 0.57 of eye.         |
| <i>L. orbignyanus</i> ..... | 38                      | 7.11                  | 2.83          | 1.83                  | 4              | To slightly beyond eye. |
| <i>L. orbignyanus</i> ..... | 32.5                    | 7.13                  | 2.85          | 1.71                  | 4.83           | To somewhat beyond eye. |
| <i>L. orbignyanus</i> ..... | 29.12                   | 7.10                  | 2.70          | 1.70                  | 2.96           | To somewhat beyond eye. |

### Family ERYTHRINIDÆ.

#### 13. HOPLIAS MALABARICUS (Bloch).

##### TARARIRA.

*Esox malabaricus* BLOCH, Ausländ. Fische, 1794, Pt. 8, p. 149, pl. CCCXII, Tranquebar.

*Macrodon malabaricus*, EIGENMANN and EIGENMANN, Proc. Cal. Ac. Sci., 2nd ser., November 8, 1889, II, pp. 101 and 102.

*Hoplias malabaricus sen tareira*, GILL, Proc. U. S. Nat. Mus., XXVI, 1903, p. 1016.

Our collection contains 2 specimens 16 and 18.5 inches in total length, respectively, of this widely distributed species. Head 3.10 and 3.21 in length without caudal; depth 3.56 and 3.97; eye 9.18 and 10.06 in head; snout 4.80 and 4.53; maxillary 1.96 and 2.06; mandible 1.68 and 1.63; pectoral 1.94 and 1.95; ventral 1.80 and 1.85; D. 14 and 12, its longest ray 2.22 and 1.91 in head; A. 9 and 10; scales 7-45-5 and 7-44-5.

### Family CHARACINIDÆ.

#### 14. CURIMATUS GILBERTI Quoy and Gaimard.

##### PAPA-TERRA.

*Curimatus gilberti* QUOY and GAIMARD, Voy. Uranie, 1824, p. 219, pl. XLVIII, fig. 1, Rio Macacu, Brazil.—EIGENMANN and EIGENMANN, Ann. N. Y. Ac. Sci., IV, 1889, p. 16.

Two specimens in our collection present the following characters: Total length 6.87 and 7 inches; head 3.89 and 3.75 in length; depth 2.88 and 2.77; eye 8 in head, 2.52 and 2.42 in interorbital; snout 3.70 and 3.63; scales 6-36-5 and 6-37-5; D. 10; A. 8 and 10.

There are several dusky spots along side and a larger spot on caudal peduncle, showing through the scales.



15. *PROCHILODUS PLATENSIS* Holmberg

## SABALO.

*Prochilodus platensis* HOLMBERG, Rev. Argent. Hist. Nat., I, 1891, p. 186, Rio de la Plata.

Holmberg says that this is the most common "Sabalo" of Buenos Aires, that it is caught with nets, is a common article of consumption, its abundance making it cheap, and that it is pretty good eating.

There are some discrepancies between the description of this fish by Holmberg and the notes taken on a single specimen from Rio de la Plata, but only such as can be accounted for by difference in size. Holmberg's type was a little over 20 inches in length (52 cm.).

Our specimen is about 12.5 inches. It is close to *P. lineatus* (Valenciennes), according to the description, but lack of material for comparison prevents certainty regarding the identity of the two. The following is a brief description of our specimen:

Head 3.88 in length without caudal; depth 3.05; eye 5.15 in head without flap; interorbital 1.81; snout 3.16; length of pectoral 1.26 in head; D. 11, its longest ray about 1.06 in head; A. 11, its longest ray 1.91 in head; ventral nearly as long as pectoral, 1.28 in head.

Two series of close-set, weak, flexible teeth in each jaw; outer series curved, teeth flat and sharp; inner series widely V-shaped, apex directed inward, teeth dilated and crenulated at tips; teeth in both series of lower jaw more closely set, overlapping each other and all dilated at tips; inner series with a wide curve inward.

16. *PARODON NASUS* Kner.

*Parodon nasus* KNER, Denks. Ak. Wiss. Wien, XVII, 1859, p. 167, "Cujabaflusse."—BERG, Anal. Mus. Nac. Buenos Aires (2d ser., II), 1896-97, p. 280 (Rio Cuyaba, República Argentina [Provincias de Córdoba, Tucuman y Salta]).

Berg states that a study of specimens from the province of Salta and an examination of the descriptions and figures given by Cuvier and Valenciennes, Reinhardt, and Lütken incline him to the opinion that *Parodon nasus* Kner is a good species and not a synonym of *Parodon suborbitalis* Cuvier and Valenciennes; that his examples correspond very well with Kner's description of *P. nasus*, with the exception that there are only 2 teeth instead of 3 on the ascending ramus of the lower jaw, a peculiarity that he does not consider sufficient for the establishment of a new species.

He says that the figures given by Cuvier and Valenciennes, Reinhardt, and Lütken represent a rather graceful and slender form, while his examples are very robust, plump, or broad, having the anterior part of the back arched, the belly broad and nearly flat, and the caudal end relatively deep. The fins, especially the pectoral, broad, and somewhat falcate or emarginate, characters that the figures of *P. sub-*

*orbitalis* Cuvier and Valenciennes and *P. hillarii* Reinhardt do not show. Berg gives the fin rays and scale counts of *P. nasus* as follows:

D. 12; A. 9; P. 15; scales 5-38 to 40-4 or 5.

Kner gives them as D. 11; A. 9; P. 15; scales  $4\frac{1}{2}$ -36 to  $38-3\frac{1}{2}$  to 4.

Steindachner has described and figured a *Parodon affinis* from La Plata<sup>a</sup> of which he gives D. 12; A. 8; P. 12; scales 5 to  $5\frac{1}{2}$ -44 to  $45-3\frac{1}{2}$  to 4, and which differs in other respects from description of figures of *P. nasus*. In his account of this species he expresses the opinion that *P. nasus* Kner and *P. hillarii* Reinhardt are synonymous with *P. suborbitalis* Cuvier and Valenciennes.

In specimens which Berg identifies with *P. affinis* he gives D. 11 or 12; A. 8; P. 12 or -13; scales  $5\frac{1}{2}$ -42 to 47-4 (Rio de la Plata; Rio Paraguay).

Perugia<sup>b</sup> lists *Parodon nasus* Kner from Tucuman and Cordoba, regarding which he says "Doctor Steindachner in describing a new species of *Parodon*, *P. affinis* (Denk. Ak. Wien, XLI, p. 20) expresses the opinion that *P. suborbitalis*, *P. nasus*, and *P. hillarii* Reinh. (Lütken, Velhas Floden Fische, p. 194, figs. 3, 4) are synonyms. From the comparison I am able to make of our specimens with the figure and description of Cuvier and Valenciennes, Kner, and Lütken, I agree exactly with Steindachner's view."

*Parodon suborbitalis* Cuvier and Valenciennes<sup>c</sup> has head less than 5; depth 4; D. 11; A. 9; scales 37.

The very limited material at our command prohibits our expressing any decided opinion regarding the value of one or the other of these somewhat contradictory views, and we are, therefore, unable to identify our 2 specimens with certainty. It is especially hard since they are young individuals not over 1.87 inches long; *P. suborbitalis* was 5 inches long; *P. nasus* Kner, over 4 inches; *P. nasus* Berg, 4.75 to  $5\frac{1}{2}$ ; *P. affinis*, about 4. However, since our specimens agree so well with Kner's description and Berg's account, we believe it safest to follow Berg and record them as *P. nasus* Kner.

We regard this as perhaps justifiable also from the fact that *P. suborbitalis* is from a region widely remote from that of the present species. The type of *P. nasus* was from Rio Cuyaba, in southwest Brazil, a tributary of the Parana flowing into La Plata. Other specimens of Weyenbergh and Berg were from the provinces of Cordoba and Salta, respectively. Ours were taken, perhaps in Rio Primero, Cordoba, or perhaps in some of the tributary waters of the Rio Negro, or possibly from La Plata.

<sup>a</sup> Ueber einige neue und seltene Fish-Arten aus dem La Plata, Denks. Ak. Wiss. Wien, XLI, 1879, p. 20, n. 1, pl. III, fig. 3.

<sup>b</sup> Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. DCXXXVII.

<sup>c</sup> Hist. Nat. Poiss., XXII, 1849, p. 51, pl. DCXXXVII, Maracaibo.

Our 2 specimens present the following characteristics: Total length in inches, 1.87 and 1.68; head, 4.44 and 4.35 in length without caudal; depth 5 and 4.11; 3.6 and 4.25 eye in head; snout 3 and 3.4; scales 6-39-4 and 5-39-5; D. 11 and 10; A. 8; P. 15.

Color, after preservation first in formalin and later in alcohol, brownish olive; from 7 to 9 large dark spots along side of back and about 17 or 18 upright oblong dark spots along side, coalescing more or less on lateral line, making a sort of irregular lateral stripe; belly pale; fins all pale.

# 17. ASTYANAX FASCIATUS <sup>a</sup> (Cuvier).

## MOJARRA.

*Tetragonopterus fasciatus* CUVIER, Mem. Mus. Hist. Nat., V, 1819, p. 352, pl. xxvi, fig. 2, rivers of Brazil.—EIGENMANN and BRAY, Ann. N. Y. Ac. Sci., VII, 1892, pp. 94, 634.

In our collection from Rio Primero, Cordoba, there are examples from about 1.65 to 3.12 inches in total length. In the majority of individuals, after preservation in formalin, there is a narrow lateral plumbeous, black stripe widening toward the tail, where it becomes a large black spot, from which the black extends upon the middle rays of caudal; a vertically oblong spot on shoulder, in some instances extending nearly to pectoral. The dorsal and anal are sometimes tipped with dusky; dorsal origin a little behind insertion of ventrals; pectoral reaching quite to ventral and ventral nearly or quite to anal; a silvery lateral stripe which is indistinct in some lights and very distinct in others; no shoulder spot evident; a very faint duskiness indicates a caudal spot; flap of skin on base of each dorsal ray mentioned by Jenyns in *T. rutilus*, white.

## Proportional measurements of *Astyanax fasciatus*.

| Head in length without caudal. | Depth. | Eye in head. | Inter-orbital. | Scales. | Dorsal. | Anal. |
|--------------------------------|--------|--------------|----------------|---------|---------|-------|
| 3.75                           | 2.81   | 3.00         | 3.00           | 6-36-5  | 10      | 20    |
| 3.66                           | 2.66   | 3.00         | 3.00           | 7-37-5  | 10      | 21    |
| 3.41                           | 2.73   | 3.00         | 3.00           | 8-35-5  | 10      | 21    |
| 3.77                           | 2.96   | 2.75         | 2.75           | 7-37-5  | 10      | 21    |
| 3.56                           | 2.92   | 2.87         | 2.87           | 7-37-5  | 10      | 21    |
| 3.77                           | 2.67   | 2.75         | 2.44           | 7-35-5  | 10      | 21    |
| 3.41                           | 2.64   | 3.00         | 3.00           | 7-35-5  | 10      | 21    |
| 3.52                           | 3.08   | 2.62         | 3.00           | 7-35-5  | 10      | 22    |
| 4.25                           | 3.09   | 2.90         | 2.66           | 7-37-6  | 10      | 25    |
| 4.29                           | 2.70   | 3.09         | 2.42           | 7-37-6  | 10      | 25    |

<sup>a</sup> According to a recent note from Dr. Eigenmann, he is of the opinion that 2 species are represented among the specimens here identified as *A. fasciatus*—one being this species, the other unrecognized. We are unable to discover any specific differences.

18. *ASTYANAX RUTILUS* (Jenyns).

*Tetragonopterus rutilus* JENYNS, Zool. Voy. Beagle, Fish, 1842, p. 125, pl. xxiii, fig. 2, Rio Parana.—EIGENMANN and EIGENMANN, Proc. U.S. Nat. Mus., 1891 (1892), p. 52 (Cauca; Canelos; Ecuador; Rio San Francisco to Rio Plata [Xamapa, Mexico]).

The present collection contains 3 specimens, the definite locality of which is unknown.

Proportional measurements of *Astyanax rutilus*.

| Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Scales. | Dorsal rays. | Longest ray in head. | Anal rays. | Long anal ray in head. | Length of pectoral in head. | Length ventral in head. |
|-------------------------|--------------------------------|--------|--------------|--------|---------|--------------|----------------------|------------|------------------------|-----------------------------|-------------------------|
| 5                       | 4.29                           | 2.71   | 3.00         | 4.80   | 7-39-6  | 10           | 1                    | 27         | 1.71                   | 1.09                        | 1.41                    |
| 4.62                    | 4.36                           | 2.90   | 3.14         | 4.40   | 8-38-6  | 10           | Longer.              | 27         | 1.69                   | 1.12                        | 1.46                    |
| 4.43                    | 4.34                           | 2.69   | 3.15         | 4.55   | 8-39-6  | 10           | Longer.              | 25         | 1.46                   | 1.07                        | 1.36                    |

19. *ASTYANAX CORDOVÆ* (Günther).

## MOJARRA.

*Tetragonopterus cordovæ* GÜNTHER, Ann. Mag. Nat. Hist., VI (5th ser.), 1880, p. 21, Rio de Cordoba.

There are 13 specimens in the present collection from Rio Primero, Province of Cordoba, 10 of them presenting the following proportional measurements, scale and fin-ray counts:

Proportional measurements of *Astyanax cordovæ*.

| Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout in head. | Inter-orbital in head. | Scales. | Dorsal. | Anal. |
|-------------------------|--------------------------------|--------|--------------|----------------|------------------------|---------|---------|-------|
| 3.43                    | 3.89                           | 3.21   | 3.80         | 3.80           | 2.71                   | 9-43-9  | 10      | 27    |
| 3.12+                   | 3.82                           | 3.19   | 3.88         | 4.37           | 2.50                   | 9-46-9  | 10      | 27    |
| 3.12                    | 3.82                           | 3.25   | 3.40         | 3.77           | 2.42                   | 8-44-9  | 10      | 26    |
| 3.12+                   | 3.82                           | 3.25   | 3.77         | 3.77           | 2.42                   | 9-42-8  | 10      | 28    |
| 3.37                    | 4.00                           | 3.27   | 4.00         | 4.00           | 2.57                   | 9-46-8  | 10      | 29    |
| 3.18                    | 3.61                           | 3.09   | 3.40         | .....          | .....                  | 9-44-9  | 10      | 28    |
| 3.06                    | 4.06                           | 3.35   | 4.12         | .....          | 2.35                   | 8-40-8  | 10      | 28    |
| 3.25                    | 4.18                           | 3.35   | 3.55         | .....          | 2.28                   | 9-45-9  | 10      | 30    |
| 3.56                    | 3.89                           | 3.36   | 3.80         | .....          | 2.53                   | 9-42-9  | 10      | 27    |
| 3.25                    | 3.78                           | 3.33   | 4.11         | .....          | 2.64                   | 9-42-8  | 10      | 30    |

Origin of dorsal over insertion of ventral; ventral reaching vent; pectoral not reaching ventral.

20. *ASTYANAX IHERINGII* (Boulenger).

*Tetragonopterus iheringii* BOULENGER, Ann. Mag. Nat. Hist., XIX, 5th ser., 1887, p. 172, San Lorenzo, Rio Grande do Sul.

Three specimens in the present collection measuring about 2.44 to 3 inches in total length; probably came from Rio Primero, Cordoba.



Body comparatively deep; dorsal outline more strongly arched than ventral, beginning rather abruptly at occiput; greatest depth in a line beginning immediately in front of dorsal; dorsal high, about equal to length of head, somewhat behind line of insertion of ventral; pectoral reaching ventral, ventral to vent.

Color, after preservation in formalin, then in alcohol, straw with silvery luster, with dusky punctulations on edges of scales above lateral line, especially pronounced on back; a diffuse silvery lateral stripe; a faint dusky shoulder spot, none on caudal peduncle; membranes of dorsal and anal and sometimes caudal finely punctulated with dusky, making the fins dusky when depressed.

*Proportional measurements of Astyanax iheringii.*

| Total length. | Head in length without caudal | Depth. | Eye in head. | Snout. | Inter-orbital. | Scales. | Dorsal. | Anal. |
|---------------|-------------------------------|--------|--------------|--------|----------------|---------|---------|-------|
| 76            | 4.33                          | 2.82   | 3.00         | 3.75   | 3.00           | 6-37-5  | 9       | 19    |
| α 68          | 4.46                          | 2.90   | 2.88         | 4.33   | 2.88           | 6-37-5  | 9       | 18    |
| 62            | 4.16                          | 2.94   | 3.00         | 4.00   | 3.00           | 7-37-5  | 9       | 17    |

α Two adipose dorsals.

21. **ASTYANAX EIGENMANNI** Evermann and Kendall, new species.

Head 4.2 in length without caudal; depth 3.15; eye 3 in head; snout 4.28; interorbital 2.72; D. 8; A. 17; scales 6-39-4. General form

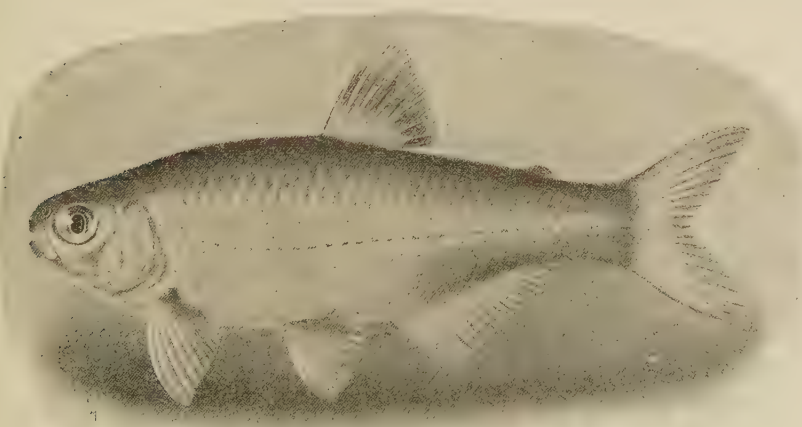


FIG. 1.—ASTYANAX EIGENMANNI. (From the type.)

somewhat oblong-elliptical; dorsal and ventral curves similar, the dorsal slightly concave at occiput; 12 scales along median line of back from occiput to front of dorsal; origin of dorsal considerably behind vertical from insertion of ventrals; height of anterior rays of dorsal about 1.15 in head; pectoral reaching base of ventral; ventral scarcely reaching origin of anal; length of anal base about equal to length of

head, the height of anterior rays about 1.5 in head; external rays of ventral and anterior rays of anal scabrous; head short, eye comparatively large; snout short and somewhat blunt; lower jaw much shorter than upper; 3 teeth on inner surface of upper end of maxillary; 2 rows of teeth on premaxillaries and 1 on mandible; all teeth 3-pointed, the middle point largest.

Color, after preservation in formalin, then in alcohol, light greenish gray; an indistinct, broad silvery lateral stripe; an indistinct, vertical, dusky shoulder spot; no spot on caudal peduncle; tips of dorsal, anal and caudal rays faintly dusky.

*Type*.—No. 55570, U.S.N.M., a specimen about 3 inches long (76 mm.) from Rio Primero, Province of Cordoba.

*Cotype*.—No. 11071, Ind. Univ. Mus., about 2.87 inches (73 mm.) in total length; head 4.06; depth 3.21; eye 3.33; snout 4.28; interorbital 3; D. 9; A. 18; scales 6–37–5. Ventral reaching vent. Color similar to type, the lateral silvery stripe more distinct; shoulder spot fainter; anterior half of anal membrane dusky between the rays.

Named for Dr. Carl H. Eigenmann, in recognition of his valuable work on the Characins.

## 22. XIPHORHAMPHUS JENYNSII Günther.

*Hydrocyon hepsetus*, JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 128 (Maldonado); not of Cuvier.

*Xiphorhamphus jenkinsii* GÜNTHER, Cat., V, 1864, p. 356 (after *Hydrocyon hepsetus*, Jenyns).

Our collection contains 2 specimens of *Xiphorhamphus* which agree very well with Jenyns' description of *Hydrocyon hepsetus*, which species Günther has considered distinct from *H. hepsetus* of Cuvier and has described under the name *Xiphorhamphus jenkinsii*. Eigenmann and Eigenmann<sup>a</sup> include *X. jenkinsii* in the synonymy of *X. hepsetus* Cuvier, the reason for which we are not able to understand. *X. jenkinsii* has fewer anal rays and fewer scales in longitudinal series. The following data are given by Jenyns: Length 4.25 inches; head in length without caudal 3.5; depth 3.5; eye in head not quite 4; D. 11; A. 25; scales 57 or 58–16.

The corresponding measurements in our 2 specimens are: Total length 8.75 and 8.87 inches; head 3.71 and 3.73 in length without caudal; depth 3.30 and 3.36; eye 5.15 and 5 in head; snout 3.76 and 3.75; D. 11; A. 25; scales 10–55–6 and 10–56–6; in the first the upper profile of the head slopes straight from the nape, in the second this outline is somewhat concave; teeth on the maxillary of uniform size; large on premaxillary and in front of lower jaw; longest dorsal ray 1.32 and 1.40 in head; longest anal ray 1.88 and 1.45 in head; pectoral 1.32 and 1.45; ventral 1.75 and 1.80.

<sup>a</sup>Proc. U. S. Nat. Mus., XIV, p. 58.

Color in alcohol: Top of head olive; black bluish gray; side silvery; trace of spot on caudal peduncle and shoulder when scales are removed; dusky punctulations on tip of dorsal and anal rays anteriorly; middle caudal rays dusky.

### 23. *CYNODON VULPINUS* (Agassiz.)

*Rhaphiodon vulpinus* AGASSIZ in Spix, Pisc. Brasil., 1829, p. 77, "Habitat in Brasiliæ fluviis".

*Cynodon vulpinus* AGASSIZ in Spix, Pisc. Brasil., 1829, pl. xxvi.—CASTELNAU, Anim. Nouv. Exped. l'Amer. Sud, Poiss., 1855, p. 75, pl. xxxix, fig. 1 (Amazon; Ucayale).—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 649 (La Plata; Santa Fe; Ascuncion, Paraguay).

There are 5 specimens in the present collection; definite locality unknown, probably from the market at Buenos Aires.

*Proportional measurements of Cynodon vulpinus.*

| Length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Maxillary including premaxillary. | Mandible. | Pectoral in length. | Ventral. | Scales. | Dorsal. | Anal. |
|-------------------|--------------------------------|--------|--------------|--------|-----------------------------------|-----------|---------------------|----------|---------|---------|-------|
| 8                 | 5.10                           | 5.27   | 4.62         | 3.70   | 1.42                              | 1.33      | 6.09                | 3.70     | 125     | 11      | 41    |
| 8.25              | 5.07                           | 5.51   | 3.16         | 3.80   | 1.40                              | 1.40      | .....               | .....    | 130     | 11      | 41    |
| 8.12              | 5.28                           | 5.78   | 5            | 3.18   | 1.40                              | 1.29      | .....               | .....    | 130     | 11      | 45    |
| 7.75              | 5.02                           | 5.67   | 5            | 3.50   | 1.40                              | 1.40      | 4.40                | .....    | 125     | 11      | 40    |
| 5.87              | 4.93                           | 5.54   | 4.50         | 3.75   | 1.42                              | 1.35      | .....               | .....    | 120+    | 11      | 44    |

## Family SILURIDÆ.

### 24. *RHAMDIA HILARII* (Cuvier and Valenciennes).

*Pimelodus hilarii* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XV, 1840, p. 180, Rio San Francisco; Montevideo.

*Rhamdia hilarii*, LÜTKEN, Velhas-Flodens Fiske, 1875, p. 174, and text figure (Lagua Santa; Rio San Francisco).—EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, p. 131 (Rio San Francisco and its tributaries; Porto Alegri south to Rio Plata).

Two specimens from Buenos Aires, from which the following notes were taken:

1. Length without caudal 12.75 inches. Head about 3.57 in length without caudal; greatest width of head 1.54 in its length; snout about 1.67; eye 9.5 in head, 3 in snout, or 3.33 in interorbital; interorbital 2.85 in head; gillrakers 3+10 on each side; fontanelle extending a little beyond eye; occipital process reaching about halfway to dorsal; D. I, 7; distance from dorsal to adipose about 10 in length of adipose, 4.5 in base of dorsal; A. 10.

2. Length without caudal 12.5 inches. Head about 3.7 in length without caudal; width of head about 1.58 in its length; interorbital 2.84; snout 3.17; eye about 8.3 in head, 2.61 in snout, and about 2.92 in interorbital; gillrakers 3+8 on the right side and 3+7 on the left;

fontanelle a little beyond eye; top of head somewhat rougher than in the preceding specimen; D. I, 7; distance from dorsal to adipose 8.66 in length of adipose, 2.4 in base of dorsal; A. 10.

25. *LUCIOPIMELODUS PATI* (Cuvier and Valenciennes).

PAT; PATI.

*Pimelodus pati* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XV, 1840, p. 176 Parana; La Plata; Corrientes; Buenos Aires.—VALENCIENNES in D'Orbigny, Voy. Amer. Merid., V, 1847, p. 7; Atlas, pl. I, figs. 7-8 (Corrientes).—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 631 ("Rio della Plata").

*Luciopimelodus pati*, EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, p. 106 (Rio Plata; Rio Branco near British Guiana).

One specimen, total length 18.75 inches. Head 3.67 in length; depth 5.22; eye 13.5 in head, 2.75 in interorbital, 6.75 in snout; snout about 2 in head; interorbital 3.09 in width of head; maxillary barbel 1.59 in length without tail; postmental barbel 1.98, mental 1.12 in head; pectoral 1.15; ventral 1.75; dorsal I, 6, height 3.11 in head; anal 11; adipose 2.95 in length without caudal, its height 11.33 in its length

26. *PSEUDOPIMELODUS ZUNGARO* (Humboldt).

MANGURUYN.

*Pimelodus zungaro* HUMBLDT, Observations, II, 1833, p. 170, pl. XLVI, fig. 1.

*Pseudopimelodus zungaro*, EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, pp. 110, 112 (Rio Plata; Rio Magdalena and the region between).

One specimen 15.25 inches total length.

Head wider than long, 3.61 in length without caudal; width of head about 3.4 in length without caudal; eye 17.6 in head, 8.4 in interorbital; maxillary barbel 1.42 in head; length of base of adipose 2 in head; D. I. 6; A., 8.

Family PYGIDIDÆ.

27. *PYGIDIUM AREOLATUM* (Cuvier and Valenciennes).

ANGUILLA.

*Trichomycterus areolatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XVIII, 1846, p. 492, Riviere de San Jago.

*Pygidium areolatum*, EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, p. 330 (Mapocho, Chile).—BERG, Anal. Mus. Nac. Buenos Aires, IV, 1895, p. 143 (Catamarca).

Nineteen specimens, 2.18 to 6.5 inches long, easily referable to this species. In some of the proportional measurements there is considerable individual variation not depending upon the size of the fish, which the following table indicates. Six of these were labeled from Rio



Comajo, Territory of Newquen, one from a tributary of Lake Traful, two from a small tributary of the Limay, and the rest were without label, but were probably from one or another of these places.

*Proportional measurements of Pygidium areolatum.*

| Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout in head. | Interorbital in head. | Nasal barbel in head. | Longest maxillary barbel in head. | Length of pectoral in head. | Length of ventral in head. | Distance from tip of snout to ventral in length without tail. | Distance from tip of snout to dorsal in length without tail. | Length of dorsal base compared with head. | Dorsal rays. | Anal rays. |
|-------------------------|--------------------------------|--------|--------------|----------------|-----------------------|-----------------------|-----------------------------------|-----------------------------|----------------------------|---------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------|--------------|------------|
| 6.50                    | 5.64                           | 6.43   | 10           | 2.08           | 3.33                  | 2.27                  | 1.56                              | 1.31                        | 1.92                       | 1.93                                                          | 1.54                                                         | Little longer...                          | 14           | 7          |
| 6.50                    | 5.94                           | 6.43   | 10           | 2.17           | 3.33                  | 2.50                  | 1.42                              | 1.33                        | 1.85                       | 1.86                                                          | 1.52                                                         | Equal.....                                | 14           | 7          |
| 6.12                    | 5.70                           | 6.22   | 9.6          | 2.00           | 3.20                  | 2.00                  | 1.54                              | 1.26                        | 1.71                       | 1.88                                                          | 1.53                                                         | Little longer...                          | 16           | 7          |
| 5.75                    | 5.81                           | 7.11   | 11           | 2.09           | 3.14                  | 2.09                  | 1.46                              | 1.33                        | 1.86                       | 1.77                                                          | 1.47                                                         | .....do.....                              | 16           | 7          |
| 4.37                    | 5.82                           | 6.66   | 11.33        | 2.12           | 3.09                  | 2.00                  | 1.30                              | 1.30                        | 1.61                       | 1.64                                                          | 1.50                                                         | Equal.....                                | 15           | 7          |
| 3.87                    | 5.54                           | 5.73   | 6.2          | 2.38           | 4.87                  | 2.58                  | 1.55                              | 1.29                        | .....                      | 1.79                                                          | 1.45                                                         | Longer.....                               | 18           | 7          |
| 2.75                    | 5.08                           | .....  | .....        | 2.18           | 3.42                  | 2.01                  | 1.50                              | 1.33                        | 2                          | 1.74                                                          | 1.56                                                         | Little longer...                          | 15           | 7          |

In the synonymy of this species, Berg includes *T. maculatus*, Girard (part), *T. cordovensis* Weyenbergh, and *T. tenuis* Weyenbergh.

28. PYGIDIUM CORDOVENSIS (Weyenbergh).

*Trichomycterus cordovensis* WEYENBERGH, Act. Acad. Nac. Cien. Buenos Aires, III, Pt. I, 1877, p. 11, pl. III, figs. 1 and 2, "Rio Primero y acequias de Cordoba."

*Trichomycterus tenuis* WEYENBERGH, Act. Acad. Nac. Cien. Buenos Aires, III, Pt. I, 1877, p. 12, pl. III, figs. A, B, C, "Laguna en la Sierra de Cordoba, cerca de la Villa Cruz-del-Eje."

*Trichomycterus tenuis* and *Trichomycterus cordovensis*, EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, p. 326.

*Pygidium areolatum*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 143 (Cordoba); in part.

Berg regards this species and *P. tenuis* (Weyenbergh) as specifically identical with *P. areolatum* (Cuvier and Valenciennes). Eigenmann and Eigenmann list these two among others as "doubtful species of *Pygidium*." They remark: "As most of the young of the species of *Pygidium* are very much alike in coloration, and usually entirely different from the adult, we are compelled to place here most of the species based on young individuals, unless they were collected together with large individuals."

We have 2 specimens easily referable to *Pygidium tenuis*; we also have somewhat larger young of *P. areolatum*, which are certainly different from *P. cordovensis* according to the description of that species by Weyenbergh. We can observe no essential differences other than those that may be due to size between *P. cordovensis* and *P. tenuis* as shown by the descriptions and figures. The most pronounced difference is in the greater length of the barbels in *P. cordovensis*. Disregarding this, *P. tenuis* may be regarded as the young of *P. cordovensis*.

Regarding *P. tenuis*, Weyenbergh states that he is inclined to believe it to represent a new genus, but the lack of literature forces him to treat the subject with caution. He therefore provisionally describes the species under the generic name of *Trychomycterus*. The most important specific characters given by him are the following:

D. 6; A. 5; P. 8; V. 6; C. 10.

Color: Dusky gray, with dull yellow belly, and yellowish fins; base of caudal dusky.

It was found in a little lake in the Sierra de Cordoba, near the town of Cruz-del-Eje. Length of largest individual 3 cm. (about 1.18 inches). The figure represents a fish similar to ours in color.

The most important points given in Weyenbergh's description of *P. cordovens*is are as follows:

D. 7; A. 5; P. 8; V. 5; C. 14.

Color: Clear sepia; fins colorless excepting middle of caudal which is dusky or plumbeous; some have dusky spots or wavy markings on the back and are somewhat dusky about the lateral line; belly pale; top of head with a dusky spot between the eye and upper barbel; this barbel dusky, the others pale. Length of largest individual 8 cm. (about 3.12 inches).

Regarding the habitat and habits of the fish Weyenbergh says that—

This little fish is caught in the Rio Primero and in the channels of Cordoba, where it searches for aquatic insects, especially larvæ of the friganids. It moves about amongst the rocks with remarkable swiftness, emptying the shells of the larvæ mentioned, constructed of gravel and stuck to the larger rocks; it is difficult to catch, since it disappears and conceals itself under the rocks and in the mud at the first sign of danger.

Description of the larger of our specimens: Total length 1.75 inches. Head 4.75 in length without caudal; eye 10.6 in head; snout 2.66; longer maxillary barbels about 2 in head; nasal barbel scarcely reaching front of eye; depth of body 7.60 in length without caudal; first pectoral ray somewhat produced, its total length 1.23 in head; length without produced ray 1.45 in head; base of ventral a little in advance of origin of dorsal; D. 9, its base 2 in head; A. 6, its origin immediately under last ray of dorsal; length of anal base 2.66 in head; distance from posterior base of anal to lower base of caudal equaling length of head; caudal emarginate.

Small example: Total length 1.62 inches. Head 5; eye 7; snout 2.80, and longest maxillary barbel 2 in head; nasal barbel just reaching front of eye; depth of body 8.75 in length without caudal; first pectoral ray somewhat produced, about 1.16 in head; without produced ray, pectoral fin 1.40 in head; base of ventral somewhat in advance of origin of dorsal; D. 9, its base 1.75 in head; A. 6, its origin under posterior end of dorsal, its base 2.14 in head; distance from posterior base of anal to lower base of caudal a little greater than length of head.

The coloration of both specimens is essentially the same. Back dusky from thick punctulations; a dusky stripe on side of back from nape along base of dorsal to its posterior end; below this a narrow stripe of straw, with dusky punctulations, to base of caudal; again, below this, along lateral line, a sharply defined black stripe to base of caudal, continued on the caudal fin as a dusky shade; side below abruptly pale, probably white in life; fins all pale; barbels dusky; head dusky above and on snout, to a little below eye; abruptly pale below.

• Locality unknown; perhaps from Rio Primero, Cordoba.

The most pronounced differences between *P. cordovensis* and *P. areolatum* are:

*P. cordovensis* has a considerably longer head; first pectoral ray produced; pectoral length without produced ray shorter; distance from tip of snout to origin of dorsal in length without tail is somewhat less, 1.66 to 1.69 in head; length of dorsal base very much shorter; dorsal rays fewer; anal rays fewer; and a great difference in coloration.

### Family LORICARIIDÆ.

#### 29. PLECOSTOMUS CORDOVÆ Günther.

*Plecostomus cordovæ* GÜNTHER, Ann. Mag. Nat. Hist., II (5th ser.), 1880, p. 11. Cordoba.—EIGENMANN and EIGENMANN, Occ. Pap. Cal. Ac. Sci., I, 1890, pp. 357 and 409 (Bon Jardin on the Río San Francisco; Port Alegre).—REGAN, Monogr. Loricariidæ, 1904, p. 212, pl. ix, fig. 3 (Cordoba).

Günther had 1 specimen, 9.5 inches long, from Cordoba, as the type of this species.

We have 7 specimens, 3.75 to 13.5 inches long, from Rio Primero, Province of Cordoba, which agree essentially with Günther's description.

The principal difference is in the coloration of the fins. According to Günther, "each ray of the caudal and pectoral is crossed by a number of short black streaks, whilst the dorsal fin is crossed by 6 or 7 black zigzag stripes."

In our examples the fins are all spotted; membranes of all fins excepting caudal with round and elliptical spots in rows on each side of and close to each ray, arranged pinnately in relation to the ray; only the first ray of each of these fins with spots; in the caudal the spots are on the rays only, sometimes extending on the membrane, making short crossbars. If the dorsal is not fully expanded the spots have somewhat the appearance of zigzag stripes; in the smallest 2 examples the spots of all the fins coalesce to some extent, and in the dorsal, especially in the smallest specimens, are actually cross stripes.

In the smallest specimen the spinules on the posterior edge of the lateral plates are proportionally larger than in the larger examples.

The plates counted in the series in the middle line of body are uniformly 28, in the series just below the dorsal, 30; the dorsal formula is always I, 7, and the anal rays 5. There are minute spines on the edge of the opercle; dorsal base considerably shorter than the distance from posterior dorsal ray to adipose, pectoral reaching somewhat beyond base of ventral and the ventral a little beyond anal.

The accompanying table shows some unimportant variation in proportional measurements according to the size of the individual:

*Proportional measurements of Plecostomus cordova.*

| Total length in inches. | Head in length without caudal, <i>a</i> | Head, <i>b</i> | Width of head in its length, <i>a</i> | Eye in interorbital width. | Snout in head, <i>b</i> | Interorbital in head, <i>b</i> | Longest dorsal in head, <i>a</i> | Longest anal ray in longest dorsal ray. | Pectoral in head, <i>a</i> |
|-------------------------|-----------------------------------------|----------------|---------------------------------------|----------------------------|-------------------------|--------------------------------|----------------------------------|-----------------------------------------|----------------------------|
| 13.5                    | 3.85                                    | 4.58           | 1.13                                  | 4.54                       | 1.34                    | 2.32                           | 1.09                             | 1.73                                    | 1.15                       |
| 11.12                   | 3.70                                    | 4.26           | 1.13                                  | 5.00                       | 1.26                    | 2.31                           | 1.11                             | 1.74                                    | 1.30                       |
| 11                      | 3.70                                    | 4.26           | 1.09                                  | 4.20                       | 1.30                    | 2.47                           | 1.15                             | 1.79                                    | 1.30                       |
| 10.5                    | 3.62                                    | 4.34           | 1.12                                  | 4.20                       | 1.27                    | 2.23                           | 1.07                             | 1.67                                    | 1.24                       |
| 9.5                     | 3.52                                    | 4.22           | 1.08                                  | 3.80                       | 1.25                    | 2.31                           | 1.06                             | 1.67                                    | 1.17                       |
| 6.87                    | 3.51                                    | 4.00           | 1.08                                  | 3.87                       | 1.36                    | 2.19                           | 1.14                             | 2.12                                    | 1.21                       |
| 3.81                    | 3.00                                    | 3.71           | 1.18                                  | 3.33                       | 1.35                    | 2.10                           | 1.44                             | 1.80                                    | 1.58                       |

*a* Head measured from tip of snout to end of occiput.

*b* Head measured from tip of snout to upper end of gill-opening.

### Family GYMNOTIDÆ.

#### 30. EIGENMANNIA VIRESCENS (Valenciennes).

##### PEZ-ESPADA OR MACHETA.

*Sternarchus virescens*, VALENCIENNES in D'Orbigny, Voy. Amer. Merid., 1847, Pt. 2, V, p. 11, pl. XIII, fig. 2.—WEYENBERGH, Act. Acad. Nac. Cien. Cordova, III, 1877, p. 6 (Las Aguas de Santa Fe).

*Eigenmannia virescens*, EIGENMANN and KENNEDY, Proc. Ac. Nat. Sci. Phila. 1903, p. 530 (Matto Grosso or Asuncion, Arroyo Trementina).—EIGENMANN and WARD, Proc. Wash. Ac. Sci., VII, 1905, p. 5 (Rio Magdalena to Rio de la Plata, east of the Andes).

We have one specimen which we identify as this species, although it disagrees slightly with the descriptions. It is a female 13.75 inches long, full of ripe eggs.

Head in total length about 12.94; depth 8.8; tail from posterior base of anal about 3.92 in total length; eye 4.25 in head; snout 28.3; pectoral about 1.13 in head; anal rays 232; scales on lateral line to opposite posterior base of anal 123.

### Family PÆCILIIDÆ.

#### 31. CNESTERODON DECEMMACULATUS (Jenyns).

*Pæcilia decem-maculatus* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 115, Maldonado.

*Girardinus decemmaculatus*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 253 (La Plata).



*Cnesterodon decemmaculatus*, GARMAN, Mem. Mus. Comp. Zool., XIX, No. 1, 1895, p. 44, pl. v, fig. 13, teeth; pl. VIII, fig. 16, male (Uruguay River, Maldonado).—BERG, Anal. Mus. Nac. Buenos Aires, V, 1897, p. 290 (Argentina; Uruguay; Brazil; Meridional).

According to Jenyns, one specimen taken by Charles Darwin at Maldonado, in a lake that had been suddenly drained, was 1.33 inches in total length, and the vertical fin formulæ were D. 8; A. 10.

One of our 3 specimens, 1 inch long, without caudal (which is broken off), and another about 1.18 total length are females containing well-grown embryos; D. 8 and A. 8 in each; scales 29 or 30-8.

Berg says that it is very abundant in quiet waters of the Province of Buenos Aires and eastern Ecuador. He gives the dorsal and anal formulæ as D. 8; A. 9 or 10; and the scales as 29 to 31-8 or 9.

### Family GALAXIIDÆ.

#### 32. GALAXIAS MACULATUS (Jenyns).

*Mesites maculatus* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 119, pl. XXII, fig. 4, Hardy Peninsula, Tierra del Fuego; River Santa Cruz, Patagonia.

*Galaxias maculatus*, GÜNTHER, Cat., VI, 1866, p. 212 (Tierra del Fuego; Patagonia).—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 654 ("*Lago e torrenti di Porto Cook*").—PHILIPPI, Verhand. Deutsch. Wiss. Santiago de Chile, III, 1895, p. 21 (Valdivia and Chile).—DELFIN, Revista Chilena Hist. Nat., III, 1901, p. 33 (Puerto Mont, Valdivia; Tierra del Fuego; Malvinas i Puerto Santa Cruz, Patagonia).—STEINDACHNER, Abhandl. Kent. Zool. Chil., I, 1898, p. 328 ("*Rio Pescado, Punta Arenas, Magellanstrasse*").

Eighteen specimens from 1.5 to 2.66 inches in total length; 12 adults most of which are gravid females, and 6 young, collected November 23, 1903, in Lake Nahuel Huapi.

The adults are clouded and marked with large spots, which consist of groups of fine dusky dots.

The young are colorless or with a few very fine dusky dots, thickest on the back and along the bases of the vertical fins.

#### Proportional measurements of *Galaxias maculatus*.

| No. | Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Dorsal. | Anal. | Pectoral in distance from its base to ventral. | Ventral in distance from its base to anal. | Sex.    |
|-----|-------------------------|--------------------------------|--------|--------------|--------|---------|-------|------------------------------------------------|--------------------------------------------|---------|
| 1   | 2.62                    | 4.72                           | 8.42   | 3.57         | 4.16   | 10      | 15    | 2.57                                           | 2.36                                       | Female. |
| 2   | 2.56                    | 4.66                           | 5.70   | 3.33         | 3.33   | 9       | 13    | 2.28                                           | 2.18                                       | Do.     |
| 3   | 2.37                    | 4.33                           | 5.47   | 4.00         | 4.00   | 11      | 14    | 2.50                                           | 2.20                                       | Do.     |
| 4   | 2.25                    | 4.16                           | 4.54   | 3.66         | 3.66   | 10      | 5 14  | 2.46                                           | 2.18                                       | Do.     |
| 5   | 2.13                    | 5.44                           | 6.12   | 3.00         | 4.5    | 11      | 15    | 2.50                                           | 2.75                                       | Do.     |
| 6   | 2.12                    | 4.27                           | 5.87   | 3.66         | 3.66   | 11      | 15    | 2.70                                           | 2.50                                       | Male.   |
| 7   | 1.87                    | 4.44                           | 3.63   | 3.60         | 4.50   | 10      | 14    | 2.00                                           | 2.50                                       | (?)     |
| 8   | 1.62                    | 4.50                           | 12     | 3.20         | 3.20   | 10      | 14    | 2.22                                           | 2.00                                       | Young.  |
| 9   | 1.5                     | 4.71                           | 9.42   | 2.80         | 3.50   | 10      | 14    | 2.22                                           | 2.33                                       | Do.     |
| 10  | 1.5                     | 4.85                           | 9.70   | 2.80         | 3.50   | 10      | 14    | 2.22                                           | 2.33                                       | Do.     |

33. *GALAXIAS TITCOMBI* Evermann and Kendall, new species.

Head 4 in length without caudal; depth 5.94; eye 4.23 in head; snout 3.92; D. 10; A. 11; snout bluntish; eye moderate, slightly shorter than snout; dorsal outline arching slightly from occiput, thence nearly straight to front of dorsal; height of dorsal 8.56 in length without caudal, its base about 2.20 in head, the first rays when depressed not reaching tip of last rays; distance from tip of snout to origin of dorsal about 1.46 in length without caudal; height of anal about 8.46 in same length, its base about 2.20 in head, the tips of first rays not reaching tips of last when depressed; distance from tip of snout to anal origin about 1.32 in length without caudal; pectoral short, rounded; ventral very short, about 2.5 in head, the distance from its origin to base of pectoral about 3.35 in length without caudal, and distance from its origin to point of anal about 5.25 in same length; caudal deeply emarginate.

Color, very pale gray, slightly more dusky on back from thick minute punctulations; irregular groups of black dots on side extending



FIG. 2.—*GALAXIAS TITCOMBI*. (From the type.)

not quite to belly, giving a clouded effect and the appearance of broken and entire crossbars; belly pale with very few dots in front of ventral; a row of black dots from base of each ventral to each side of vent; fins pale, with some punctulations, head thickly punctulated above, on snout, and on side about to level of upper jaw, abruptly pale below.

*Type*.—Cat. No. 55571, U.S.N.M., a specimen 5.62 inches long, collected December 13, 1903, by Mr. John W. Titcomb, from Rio Traful near Lake Traful, Argentina.

We take pleasure in naming this interesting species for Mr. John W. Titcomb, assistant in charge Division of Fish Culture, United States Bureau of Fisheries, under whose direction the present collection of fishes was made.

We have a second specimen (cotype, No. 1439, Bureau of Fisheries) which may be briefly described as follows:

Total length about 2.5 inches. Head 4.15 in length without caudal; depth 6.75; eye 4.33 in head; snout 3.71; D. 10; A. 10, its height 7.71 in length without caudal; pectoral rounded, about 1.85 in head; ventral

short, its height 2.16 in head. Coloration similar to that of the type, but the groups of spots forming somewhat more definite crossbars.

Ten species of *Galaxias* are recorded from South American waters. These are founded upon specimens ranging from 2 or 3 to 13 inches in length. It is not improbable that some of these nominal species may be based on characters due to differences in size and age, and therefore not of specific value. It is not impossible that the present species is the young of some known species, but the data available do not show it. It is closely related to *G. maculatus* (Jenyns), as indicated by specimens before us which we have identified as that species. It is also close to *G. alpinus* Smitt<sup>a</sup> from R. Azopardo, Admiralty Sound.

Smitt suggests the possibility of *G. alpinus* being identical with *G. maculatus*, or *G. coppingeri* (Günther), saying "The length of the head prevents me calling this fish *Galaxias maculatus*, and the length of the ventrals, compared with the post-abdominal, is very much greater than in *Galaxias coppingeri*, as described by Günther. Nevertheless I am of the opinion that the difference in this respect may be transitory."

Our specimens differ from *G. maculatus* chiefly in the blunter snout, smaller eye, usually higher dorsal and anal, fewer anal rays, and somewhat different coloration; the group of dots being more irregular and fewer, this giving the fish less of a clouded or marble appearance.

From *G. alpinus* Smitt, it differs amongst other things, in having a much smaller eye, somewhat longer snout, higher anal, and much shorter pectoral compared with the length of the head, and there are fewer anal rays.

Proportional measurements of species of *Galaxias*.

| Species.                        | Total length in mm. | Depth in length without caudal. | Head. | Eye in head. | Snout. | Dorsal rays. | Height of dorsal in length without caudal. | Anal rays. | Height of anal in length without caudal. | Pectoral in head. | Pectoral in distance from its base to ventral. | Ventral in head. | Anal in its distance from base of ventral. |
|---------------------------------|---------------------|---------------------------------|-------|--------------|--------|--------------|--------------------------------------------|------------|------------------------------------------|-------------------|------------------------------------------------|------------------|--------------------------------------------|
| <i>Galaxias titcombi</i> .....  | 65                  | 5.94                            | 4     | 4.23         | 3.92   | 10           | 8.56                                       | 11         | 8.46                                     | 1.89              | 2.24                                           | 2.50             | 1.61                                       |
|                                 | 54                  | 6.75                            | 4.15  | 4.33         | 3.71   | 10           | 7.71                                       | 10         | 7.71                                     | 1.85              | 2.42                                           | 2.16             | 1.62                                       |
| <i>Galaxias maculatus</i> ..... | 65                  | 5.7                             | 4.75  | 3.42         | 3.42   | 9            | 8.76                                       | 14         | 8.14                                     | 1.71              | 2.14                                           | 2.40             | 2.50                                       |
|                                 | 60                  | 5.7                             | 4.33  | 4            | 4      | 11           | 9.45                                       | 15         | 9.45                                     | 2                 | 2.33                                           | 2.40             | 2.20                                       |
| <i>Galaxias alpinus</i> .....   | 43                  | 8.38                            | 4.32  | 3.48         | 4.59   | 10           | (?)                                        | 12         | 9.91                                     | 1.69              | 2.18                                           | 2.01             | 1.85                                       |
|                                 | 54                  | 7.86                            | 4.05  | 3.90         | 4.50   | 10           | 7.86                                       | 13         | 7.86                                     | 1.70              | 2.20                                           | 2.19             | 1.85                                       |

<sup>a</sup>Poisson de L'Expédition Scientifique à la Terre de Feu, Bihang till K. Svenska Vet.-Akad. Handlingar, XXIV, 1895-1897, p. 118, pl. x, figs. 40 and 40a.

## Family ATHERINIDÆ.

ODONTESTHES Evermann and Kendall, new genus.

*Odontesthes* Evermann and Kendall, new genus of *Atherinidæ* (*O. perugiæ*).

This genus differs from *Basilichthys* in having 2 rows of comparatively long, sharp teeth on each jaw, and conspicuous vomerine teeth, instead of several series of fine sharp jaw teeth and no teeth on the vomer as in the latter genus.

(οδούς, tooth and ἐσθίω, eat.)

34. ODONTESTHES PERUGIÆ Evermann and Kendall, new species.

*Atherinichthys vomerina*?, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 621 (Montevideo).

*Atherinichthys vomerina*, BERG, Adal. Mus. Nac. Buenos Aires, IV (2d ser., 1,) 1895, p. 26 (Costa Patagonica; Mar del Plata, Montevideo); not *Atherina vomerina* CUVIER and VALENCIENNES.

Head 4.17 in length without caudal; depth 7.31; eye 4.66 in head, 1.08 in interorbital; snout 3.11; D. IV-8; A. 14; scales 50-10.

Body comparatively slender, somewhat compressed, belly rounded; head flat above, scaleless; snout long, depressed, lower jaw slightly



FIG. 3.—ODONTESTHES PERUGIÆ. (From the type.)

shorter than the upper, with comparatively long, sharp, somewhat hooked teeth, in 2 rows in each jaw; somewhat smaller but similar teeth on head of vomer arranged in 3 groups, connected by a single row of still smaller, similar teeth; no teeth on palatines; eye moderate; scales entire; pectoral moderately long, 1.27 in head; posterior portion of first dorsal about over anterior portion of anal; second dorsal inserted posterior to middle of anal.

Color (after preservation in formalin and later in alcohol), generally pale yellowish gray; a silvery stripe below spinous dorsal occupying lower part of fourth, whole of fifth and upper part of sixth scale of the transverse series; margin and tip of snout black; few black dots on back, thickest on margins of scales posterior to dorsal; bases of posterior 5 dorsal rays dusky; extremity of caudal broadly dusky, other fins pale.

One specimen, the type, Cat. No. 55572, U.S.N.M., 5.62 inches long, Argentina; locality label lost; probably from fresh water.



Named for Alberto Perugia, of the Natural History Museum of Genoa, in recognition of his work on South American fishes.

Perugia describes a specimen from Montevideo as doubtfully *Atherinichthys vomerina* Cuvier and Valenciennes.

*Atherina vomerina* Cuvier and Valenciennes was from Mexico, and is now considered identical with *A. humboldtiana* of the same authors, and as belonging to the genus *Chirostoma*, with which the generic name *Atherinichthys* must be considered synonymous, since it was based on *A. vomerina*.

Berg also records *Atherinichthys vomerina*, regarding which he says that it affects salt water, and is rarely found in the mouths of rivers and those lakes which have immediate communication with the Atlantic Ocean; that it is distinguished from other species which reach a considerable size in having 2 or 3 groups of small teeth on the vomer, in some examples, abnormally, a single group. He states that he had some examples in which the upper lobe of the caudal was the longer, and others with a triangular spot on the pectoral, and that the number of dorsal and anal spines and rays are very variable, giving the fin and scale formulæ as follows: D. IV to VII-9 to 11; A. 17 to 20; scales 48 to 56-10 or 11.

In the synonymy of this species he includes *A. vomerina*, Perugia. On page 27 of Berg's *Enumeración* he describes a new closely related species, from Mar del Plata, under the name *Atherinichthys platensis*, which differs from the present species principally in the number of scales, which he gives as about 70-15 or 16. This species evidently belongs in our genus *Odontesthes* and should stand as *Odontesthes platensis* (Berg).

### 35. BASILICHTHYS BONARIENSIS (Cuvier and Valenciennes).

#### PEJERREY.

*Atherina bonariensis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1835, X, p. 469, Río de la Plata, near Montevideo.

*Atherinichthys bonariensis*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 620 (Laguna Ihera, near Corrientes).—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 30 (Montevideo; Maldonado; Mar Chiquita).

According to Berg this species is rare in salt water, but abounds in the lakes and rivers, attaining a large size. He says that the species is distinguished from the others that he has mentioned (*A. vomerina*, *A. platensis*, *A. microlepidotus*, *A. laticlavia*, and *A. argentinensis*) principally by its smaller eye, which is contained 6 or 7 times in head, and the head about 4 in length of the fish.

In our collection there are specimens from 4 to 21.5 inches long. The proportional size of the eye alone is an unreliable character, since it is somewhat in inverse ratio to the size of the fish.

*B. bonariensis* is distinguished from *B. microlepidotus* by the rather longer and sharper snout and larger scales.

According to Mr. Titcomb the pejerreys are regarded in Argentina as the most valuable fresh-water fish of the country. They inhabit both fresh and salt water. During the winter months one species at least (*B. bonariensis*), is said to ascend the Rio de la Plata above Buenos Aires where it is caught by anglers with two or three hooks attached to one line very much as smelt are caught through the ice in the tidal rivers of New England. However, they do not have any ice in the Rio de la Plata. Mr. Titcomb found this pejerrey in Lake Chascomus, about two hours' railroad journey from Buenos Aires, where commercial fisheries have their existence. The Chascomus is almost a sea-level lake, having an outlet to the sea during periods of high water. The lake is shallow and is reported to have run dry on one occasion so that the fish were all exterminated. Apparently the pejerrey enter this lake from salt water for the purpose of spawning. The first examples seen in this lake were observed by Mr. Titcomb October 20, and he thinks the spawning season of the pejerrey in the latitude and elevation of Chascomus would be about the latter part of October and the early part of November. The water temperature in Chascomus Lake must become very high in midsummer, and the water is rather sluggish and roily. He next encountered the pejerrey (*B. microlepidotus*) in the Rio Negro in latitude 39°, south but found no spawning fish among them. They were seen at several points on the Rio Limay and its tributaries in the early part of November, and they were found spawning in tributaries of Lake Nuhuel Huapi in the latter part of November. The species seems to be fairly abundant in the Rio Limay and in tributaries of the lake. They evidently go to the lakes and enter the tributary streams for spawning purposes. At Lake Traful the pejerrey was found spawning December 13. It evidently spawns on a rising temperature. The wind blows for days at a time on these lakes in the Andes Mountains, sometimes for two weeks without ceasing. Apparently the fish in Lake Traful had been waiting for the wind to go down, and when it did go down the afternoon in question they entered the small bays for spawning purposes, where about 500 pounds were taken at one haul with a 100-foot Baird seine. Mr. Titcomb was informed by responsible persons that the pejerrey is found in waters of Argentina as far south as the Strait of Magellan. Both the trucha and pejerrey are said to be abundant in the latitude of Chile corresponding to those in which it is found in Argentina.

Some of the fish enter rivers tributary to the lakes to spawn, and others select the shallow sandy bottoms of the lakes near the shore, but not necessarily in sheltered places.

Both pejerrey and trucha, in ripe spawning condition, were frequently caught in one and the same haul of the collecting nets.

The pejerrey is quite as prolific as the trucha, its eggs are capable of artificial fertilization, and the species can be artificially propagated.

Since Mr. Titcomb's return from Argentina the pejerrey has been propagated to a limited extent. The eggs were obtained from fish caught in Lake Chascomus, transferred to Buenos Aires and placed in McDonald jars. After being eyed they were distributed in lakes not known to contain any fish and left to nature's care. Fish Culturist Tulian, who was placed in charge of the work after the methods had been developed by Mr. Titcomb, states that when the eggs were thus placed in the lakes he sheltered them with a network of brush to keep away predaceous birds. He reports that he has heard from one of the lakes where these eggs were planted, that numbers of small fish have since been seen, and he believes the plant was a success.

The eggs are quite adhesive in their nature, and should apparently be handled much like those of the pike perch. It is the policy of the present administration in Argentina to propagate the pejerrey on a large scale and distribute them in waters not now productive.

The largest pejerrey seen by Mr. Titcomb was taken in Lake Trafal and measured 48 cm. long (probably *B. microlepidotus*).

*Proportional measurements of Basilichthys bonariensis.*

| Total length in inches. | Head in length without caudal. | Eye in head. | Snout. | Eye in interorbital. | Scales. | Dorsal. | Anal. | Pectoral in head. |
|-------------------------|--------------------------------|--------------|--------|----------------------|---------|---------|-------|-------------------|
| 21.5                    | 4.15                           | 7.43         | 2.97   | 2.18                 | 61-14   | VI-10   | 18    | 1.48              |
| 21.5                    | 4.31                           | 8.21         | 3.10   | 2.49                 | 60-14   | V-11    | 19    | 1.41              |
| (a)                     | -----                          | 7            | 3.15   | 1.88                 | 60-14   | V-19    | 16    | 1.34              |
| (a)                     | -----                          | 7.50         | 3.26   | 2                    | 54-14   | VI-11   | 18    | 1.36              |
| (a)                     | -----                          | 6.69         | 3.10   | 2.07                 | 54-13   | IV-10   | 18    | 1.24              |
| 12                      | 4.83                           | 5.60         | 3.06   | 1.8                  | 55-12   | III-9   | 18    | 1.19              |
| 10.75                   | 4.28                           | 6.22         | 3.06   | 1.55                 | 56-14   | V-10    | 17    | 1.24              |
| 8.75                    | 4.25                           | 4.88         | 3.14   | 1.44                 | 55-14   | V-10    | 16    | 1.15              |
| 9.84                    | 4.10                           | 6.25         | 4.16   | 1.75                 | 55-14   | V-10    | 16    | 1.19              |
| 7.25                    | 4.41                           | 5.50         | 3.38   | 1.62                 | 55-14   | V-10    | 17    | 1.10              |

a Deformed.

36. *BASILICHTHYS MICROLEPIDOTUS* (Jenyns).

PEJERREY DE MANILA; PEJERREY DE MALVINAS.

*Atherina microlepidota* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 78, pl. xvi, fig. 1, 1a, 1b, Valparaiso.

*Antherinichthys microlepidotus*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 32 (Bocca del Rio Negro).—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 66 (Costa patagonica; Mar del Plata; Montevideo).

Berg states that this species is usually small. Those that occur in Mar del Plata and Mar Chiquita measure usually from 15 to 17 cm. in length. He further says that according to Eigenmann and Eigen-

mann it inhabits fresh water, but that he knows of it only in the mouth of rivers, in brackish water; for example, the Rio Negro in northern Patagonia.

We have 24 specimens that we identify as this species from lakes Nahuel Huapi and Trafal and from Nirihuahu, tributary of Rio Limay.

Our specimens range in total length from 1.43 to 13.5 inches, agreeing very well with Jenyns' description and figure.

The following table of proportional measurements indicates the range of variation in specimens of the various sizes:

*Proportional measurements of Basilichthys microlepidotus.*

| Locality.                 | Length. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Interorbital. | Scales. | Dorsal. | Anal. | Base of anal in head. | Pectoral in head. |
|---------------------------|---------|--------------------------------|--------|--------------|--------|---------------|---------|---------|-------|-----------------------|-------------------|
| Uncertain .....           | 13.5    | 4.92                           | 4.92   | 5.72         | 3.31   | 2.86          | 76      | VI-10   | 15    | 1.23                  | 1.43              |
| Lake Trafal .....         | 10.5    | 5.                             | 5.22   | 4.70         | 3.35   | 2.93          | 74      | III-10  | 15    | 1.20                  | .....             |
| Do. ....                  | 7       | 5.12                           | 6.11   | 4.13         | 3.75   | .....         | 70      | II-10   | ..... | .....                 | .....             |
| Do. ....                  | 5       | 4.78                           | 7.33   | 3.53         | 3.28   | 3.53          | 70      | V-10    | 15    | 1.24                  | 1.39              |
| Do. ....                  | 5.25    | 4.68                           | 6.88   | 4.16         | 3.57   | 3.33          | 72      | IV-10   | 15    | 1.19                  | 1.31              |
| Lake Nahuel Huapi .....   | 6       | 4.94                           | 5.69   | 4.07         | 3.55   | 3.31          | 72      | VII-10  | 15    | 1.26                  | .....             |
| ?Tributary Limay Basin .. | 3.62    | 4.78                           | 7.18   | 3.30         | 3.30   | 3.66          | 70      | V-10    | 15    | 1.26                  | 1.37              |

## Family MUGILIDÆ.

### 37. MUGIL BRASILIENSIS Agassiz.

#### LISA.

*Mugil brasiliensis* AGASSIZ in Spix, Pisc. Brasil., 1829, p. 134, pl. LXXII, Atlantic Ocean.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 31 (Costa patagonica; Bahia Blanca, Mar del Plata, Cabo de San Antonio; Montevideo; Maldonado).

*Mugil liza*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 622 (Montevideo).

Berg has shown that this species exhibits considerable variation in form according to the size of the fish, and in color according to the character of the water inhabited. It enters brackish and fresh water.

The following notes taken from the 4 specimens representing this species from Rio de la Plata in our collection show some variation in proportional measurements in examples of about the same size:

(1) Total length 12 inches; length without caudal 9.67 inches. Head 3.85 in length without caudal; interorbital 2.10 in head; D. IV-8; A. III, 8; scales 36 or 37, -12.

(2) Total length 13 inches; length without caudal 11 inches. Head 4.09; interorbital 1.79; D. IV-8; A. III, 8; scales 35, -12.

(3) Total length 13 inches; length without caudal 10.5. Head 4; interorbital 1.90; D. IV-8; A. III, 8; scales 35, -12.

(4) Total length 13.5 inches; length without caudal 11. Head 4.09; interorbital 1.95; D. IV-8; A. III, 8; scales 35, -12.



## Family SCOMBRIDÆ.

## 38. SCOMBER JAPONICUS Houttuyn.

## CABALLA.

*Scomber japonicus* HOUTTUYN, Verhand. Holland. Maats. Weet. Haarl., XX, p. 21, Japan.

*Scomber colias* GMELIN, Syst. Nat., I, 1788, Pt. 4, p. 1329, Sardinia.

*Scomber scombrus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 40 (Mar del Plata; Montevideo).

Regarding this species, which he believes to be *S. scombrus*, Berg says that the swimming bladder is absent, rendering the determination of the species absolutely certain, and that individuals have been observed with only 10 spines in the dorsal fin. According to Jordan and Evermann,<sup>a</sup> the dorsal fin formula of *S. scombrus* is XI-12 with 5 finlets; and of *S. colias=japonicus*, IX-I, 12 and 5 or 6 finlets. Thus the number of dorsal spines given by Berg applies to the present species rather than to *S. scombrus*, yet the number of spines doubtless varies somewhat in both species. If the air-bladder is really absent, the fish mentioned by Berg was *S. scombrus*, but it may be that the air-bladder was overlooked, as it may easily be under certain circumstances, especially when the viscera are somewhat macerated. Under these circumstances, and since the single specimen in our collection is undoubtedly *S. japonicus*, it is not improbable that Berg's specimen also was of this species.

Regarding its abundance, Berg states that it has been observed a very few times at Montevideo and Mar del Plata, where many were caught near the end of January and first of February, 1895.

Our specimen from Mar del Plata presents the following characters: Total length, 13.5 inches; length without caudal, 12 inches. Head 4 in length without caudal; depth 1.26; eye 4.8 in head; maxillary about 2.08, and mandible 1.84; D. VIII-I, 11+5 finlets, the longest spine 2 in head; A. I, 10+5 finlets; pectoral 2 in head.

## Family CARANGIDÆ.

## 39. PARONA SIGNATA (Jenyns).

## PALOMETA.

*Paropsis signata* JENYNS, Zool. Voy. Beagle, Pt. 4, V, Fish, 1842, p. 66, pl. XIII, northern coast Patagonia.—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 614 (Montevideo; Bacino del Rio Santa Cruz).

*Parona signata*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 39 (Bahia de Santa Cruz; Bahia Blanca; Mar del Plata; Montevideo).

Berg says that this species is very common along the whole coast, and is caught at Montevideo at certain times of the year in enormous

<sup>a</sup> Fishes North and Mid. Amer., Pt. 1, 1896, pp. 865, 866.

quantities. He calls attention to the fact that the description by Jenyns has been corrected and added to by Steindachner, Lütken, and Perugia, and that the black spot under the pectoral is variable in intensity and extent, and is occasionally absent.

Regarding the size attained by this species, Berg says that he saw one measured at Montevideo that was 45 cm. [over 18 inches] long without the tail, and 18 cm. in height.

Our collection contains 5 specimens 14.25 to 16.5 inches in total length, from Mar del Plata. The following notes were taken from our largest example:

Total length from tip of lower jaw to tip of caudal 16.5 inches; length to fork of caudal 14.75 inches, and to base of caudal 14; depth 2.33 in length without caudal; D. I-I-I-I-I, 32, the longest soft rays or anterior lobe, 1.46 in head; A. I-I, 32, the longest rays or anterior lobe, 2.03 in head; head from tip of lower jaw to gill-opening, 3.92 in length without caudal; eye 6.33 in head; snout 4.07; distance from tip of snout to posterior extremity of maxillary a little less than 7 in head; width of posterior extremity of maxillary 1.4 in snout.

The soft dorsals of our other specimens contain 33, 39, 34, and 35 rays, respectively.

Berg gives the vertical fin counts as D. VII, 1, 33-34 (rara V. 35-I, 36); A. II, I, 34-36 (II, I, 37).

#### Family SERRANIDÆ.

##### 40. PERCICHTHYS TRUCHA (Cuvier and Valenciennes).

###### TRUCHA.

*Perca trucha* CUVIER and VALENCIENNES, Hist. Nat. Poiss., IX, 1844, p. 429, Rio Negro, Patagonia.

*Perca levis* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 122, pl. 1, Santa Cruz River, Patagonia.

Cuvier and Valenciennes say that this fish seems to abound in the fresh waters, neither ascending from nor descending to the sea; that the inhabitants call it "trucha," which is the Spanish name for trout. It is also said to be "delicate eating" and highly esteemed. It attains a foot in length.

Mr. Titcomb found the trucha along with the pejerrey in the Rio Negro in south latitude 39°, but no spawning fish were among them. He found them together at several places also in the Rio Limay and its tributaries early in November. Late in that month they were found spawning in Lake Nahuel Huapi. They seemed to be abundant both in the Rio Limay and in tributaries to the lake, which they ascend at spawning time, which appears to be in December, as Mr. Titcomb obtained spawning fish December 13.

The largest trucha seen by Mr. Titcomb was taken in Lake Traful, and measured 48 cm. long.

The eggs of a mature female trucha were counted and measured. From these data it is estimated that the trucha yields about 35,000 eggs to the pound.

In the present collection are a number of specimens 1.5 to 16.5 inches long; and we have before us some specimens from Chile kindly loaned by Prof. Samuel Garman, of the Museum of Comparative Zoology in Cambridge, Massachusetts, and have examined the types of *Percichthys chilensis* Girard, which are in the United States National Museum. A study and comparison of this material indicate that there may be two species represented. Among them are three large examples (15 to 16.5 inches long) which have about their heads a Sciænoid appearance, as mentioned by Cuvier and Valenciennes, and by Kner. There are also about a dozen of smaller size (from 1.5 to 12.5 inches) which bear more resemblance to a perch than to a Sciænoid. They agree with the description of *P. trucha* Cuvier and Valenciennes and with the description and figure of *P. lævis* Jenyns.

Between these two sizes there are some notable differences, but none, perhaps, which may not be accounted for by the difference in size. In the large specimens the eye is somewhat smaller, the inter-orbital wider, and the maxillary longer than in the others. They have also a heavier appearance about the head, and the caudal peduncle seems stouter. The evidence, however, is insufficient to justify us in regarding them as distinct.

The following table shows the variation in proportional measurements, etc., in the two sizes:

*Proportional measurements of Percichthys trucha.*

| Locality.          | No. | Total length in inches. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Maxillary. | Mandible. | Inter-orbital. | Pre-orbital. |
|--------------------|-----|-------------------------|--------------------------------|--------|--------------|--------|------------|-----------|----------------|--------------|
| Lake Traful.....   | 1   | 16.5                    | 3.33                           | 3.88   | 7.13         | 3.56   | 2.74       | 2.14      | 3.95           | 5.35         |
| Do.....            | 2   | 16.25                   | 3.68                           | 3.83   | 7.14         | 3.70   | 2.63       | 2.27      | 4              | 5.26         |
| Do.....            | 3   | 15                      | 3.92                           | 4.45   | 7.39         | 3.40   | 2.65       | 2.23      | 3.86           | 5.30         |
| Arroyo Comajo..... | 4   | 12.5                    | 3.81                           | 3.88   | 6.56         | 3.72   | 2.82       | 2.15      | 4.55           | 4.82         |
| Do.....            | 5   | 11.5                    | 3.62                           | 3.52   | 6.14         | 3.88   | 2.84       | 2.08      | 4.43           | 4.58         |
| Do.....            | 6   | 9                       | 3                              | 3.36   | 6.50         | 3.93   | 2.76       | 2.28      | 5.20           | 5.20         |
| Do.....            | 7   | 7.37                    | 3.10                           | 3.29   | 5.26         | 3.57   | 2.94       | 2.27      | 5              | 5            |

| Locality.          | Scales.  | Dorsal fin. |                        | Anal fin. |                        | Number of gill-rakers. | Longest gill-raker in eye. |
|--------------------|----------|-------------|------------------------|-----------|------------------------|------------------------|----------------------------|
|                    |          | Formula.    | Longest spine in head. | Formula.  | Longest spine in head. |                        |                            |
| Lake Traful.....   | 9-70-16  | IX-I, 11    | -----                  | II-I, 9   | 5.09                   | 6+13<br>6+13           | 2.72                       |
| Do.....            | 10-70-17 | IX-I, 11    | 3.57                   | II-I, 8   | 6.25                   | 6+13<br>5+14           | 2                          |
| Do.....            | 10-70-17 | X-I, 11     | 2.57                   | II-I, 9   | 4.72                   | 6+13<br>6+13           | 1.70                       |
| Arroyo Comajo..... | 12-70-17 | IX-I, 10    | 3.03                   | II-I, 8   | 5.65                   | 7+13<br>6+13           | 2.77                       |
| Do.....            | 10-70-17 | IX-I, 10    | 2.44                   | II-I, 8   | 4.30                   | 5+14<br>5+14           | 2.30                       |
| Do.....            | 10-70-17 | IX-I, 11    | 2.24                   | II-I, 8   | 4.64                   | 5+12<br>5+13           | 2.50                       |
| Do.....            | 10-70-17 | IX-I, 10    | 1.96                   | II-I, 9   | 4.16                   | -----                  | -----                      |

## 41. ACANTHISTIUS PATACHONICUS (Jenyns).

## MERO.

*Plectropoma patachonica* JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 11, off mouth Rio de la Plata, coast of Patagonia.

*Acanthistius patachonicus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 46 (Costa patagonica; Bahia Blanca; Mar del Plata; Montevideo; Maldonado).

Berg reports this species as abundant in all the places mentioned, and points out marked differences between it and *A. brasiliensis*.

Eight specimens in our collection from the market at Buenos Aires measure from 7.75 to 19 inches in total length. There is some variation, according to size, as shown in the accompanying table:

*Proportional measurements of Acanthistius patachonicus.*

| Total length. | Head in length without caudal. | Depth. | Eye in head. | Snout. | Maxillary. | Mandible. | Interorbital. | Scales. | Dorsal.    | Anal.  |
|---------------|--------------------------------|--------|--------------|--------|------------|-----------|---------------|---------|------------|--------|
| 19            | 2.42                           | 2.56   | 6            | 4.5    | 2.34       | 1.88      | 5.78          | 100     | XII, I, 15 | III, 8 |
| 11+           | 2.32                           | 2.76   | 5.15         | 4.08   | 2.22       | 1.88      | 6.53          | 94      | XII, I, 15 | III, 8 |
| 9.5           | 2.23                           | 2.68   | 4.80         | 4.68   | 2.28       | 1.93      | 7.41          | 94      | XII, I, 15 | III, 8 |
| 8.25          | 2.33                           | 2.77   | 4.83         | 4.41   | 2.34       | 2.14      | 7.50          | 97      | XII, I, 15 | III, 8 |
| 7.5           | 2.43                           | 2.63   | 4.64         | 4.33   | 2.19       | 1.96      | 7.22          | 95      | XII, I, 15 | III, 9 |

The specimens were first preserved in formalin and later placed in alcohol, and the colors have become very much faded; but the ground color of the body seems to be gray, covered with fine reticulations of very dark-brown wavy markings; belly plain brownish and gray without markings; head the same; fins all plain brownish, but with wavy brown markings at base of spinous dorsal and scaly portions of soft dorsal and anal.

## Family SPARIDÆ.

## 42. PAGRUS PAGRUS (Linnæus).

*Sparus parus* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 279, southern Europe.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 49 (Mar del Plata; Montevideo).

*Pagrus vulgaris*, PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 612 (Market of Montevideo).

Berg says that this species is rather common in Mar del Plata and about Montevideo, and occurs in other localities on the Argentine and Uruguayan coasts.

He gives vertical fin and scale formulas, as follows: D. XI 12 to XII, 11; A. 8; scales 6-53 to 56-13.

Two specimens in our collection, 12 and 13.37 inches total length, present respectively the following proportions: Head 3.04 and 3.22 in length without caudal; depth 2.55 and 2.68; eye 4.10 and 4.09 in head; D. XII, 10; A. III, 8; scales 7 and 9-56 and 57-14.



## Family SCIÆNIDÆ.

## 43. MACRODON ANCYLODON (Bloch and Schneider).

## PESCADILLA DEL RED.

*Lonchurus ancylodon* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 102, pl. xxv, Surinam.

*Ancylodon jaculidens* CUVIER and VALENCIENNES, Hist. Nat. Poiss., V, 1830, p. 81, Cayenne.

*Ancylodon atricauda* GÜNTHER, Challenger Rept., Zool., I, 1880, p. 12, mouth of the Rio de la Plata.

*Ancylodon ancylodon*, JORDAN and EIGENMANN, Rept. U. S. Fish Comm., XIV, 1886 (1889), pp. 372, 373 (both coasts of tropical America; Surinam; Panama).

*Sagenichthys ancylodon*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 52 (Mar del Plata; Montevideo; Maldonado).

*Macrodon ancylodon*, GILL, Proc. U. S. Nat. Mus., XXVI, 1903, p. 1015.

According to Berg, this fish is very highly esteemed for its delicate flesh. On account of its comparative scarcity, it brings a rather high price in the markets.

Our collection contains 5 individuals from Mar del Plata, from 4 of which the following notes were taken:

*Proportional measurements of Macrodon ancylodon.*

| Total length. | Head in length without caudal. | Eye in head. | Snout. | Dorsal. | Anal. |
|---------------|--------------------------------|--------------|--------|---------|-------|
| 13            | 3.53                           | 6.75         | 4.05   | ×-I, 27 | I, 9  |
| 13 ?          | 3.63                           | 6.50         | 4.33   | ×-I, 28 | I, 10 |
| 12.5          | 3.61                           | 6            | 4.16   | ×-I, 27 | I, 9  |
| 15            | 3.60                           | 6.69         | 4.14   | ×-I, 27 | I, 10 |

## 44. CYNOSCION STRIATUS (Cuvier).

## PESCADILLA.

*Otilithus striatus* CUVIER, Règne Animal., 2d ed., 1829, p. 173, note.

*Otolithus guatucupa*, JENYNS, Zool. Voy. Beagle, Part IV, Fish., 1842, p. 41 (Maldonado Bay, Rio Plata).

*Cynoscion striatus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 56 (Bahia Blanca; Mar del Plata; Montevideo; Maldonado).

According to Berg, next to *Micropogon undulatus*, this is the most abundant species on the Uruguayan coast, appearing principally in the months of January and February and July and August.

Berg gives the fin and scale counts as follows:

D. X-I, 19 to 21; A. II, 9 or 10; scales 56 to 60; and says that the anal often has 2 spines (authors give one only), of which the first is very small and concealed.

Young *Cynoscion regalis* usually has 2 anal spines, and probably small examples of the present species usually have 2, the first growing smaller and disappearing with age.

We have 2 specimens 18.5 and 19.5 inches long, respectively, presenting the following proportional measurements: Head 3.30 in length without caudal; eye 6.20 and 5.90 in head and 1.20 and 1.04 in interorbital; snout 4.27 and 4.33; maxillary 2.33 and 2.32; mandible 1.85 and 1.88; scales 6-57-5 and 6-62-7; D. VIII-I, 20, and VIII-I, 18; A. I, 8 and I, 9.

#### 45. MICROPOGON UNDULATUS (Linnæus).

CORVINA; CURVINA; CURBINA; RONCADERA.

*Perca undulata* LINNÆUS, Syst. Nat., 12th ed., 1766, p. 483.

*Micropogon undulatus*, GÜNTHER, Challenger Rept., Zool., I, 1880, p. 13 (Montevideo); Ann. Mag. Nat. Hist., 5th ser., 3, July, 1880, p. 9 (Rio de la Plata).—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 613 (Montevideo).—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 54 (Bahia Blanca; Mar del Plata; Montevideo; Maldonado).

*Micropogon furnieri*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 55 (Embocadura del Rio de la Plata; Montevideo).

According to Berg, this species is very common on the coast from Parrelo to Maldonado, and the number caught in the Uruguayan region reaches 3 or 4 millions annually.

Berg, on the authority of Günther, records also *Micropogon furnieri* from the mouth of Rio de la Plata.

Günther did not consider the South American *Micropogon* as distinct from the northern *M. undulatus*.

The stated distinctive characters of *M. furnieri* in Jordan and Eigenmann's Review of the Sciaenidæ, from an examination of our specimens and comparison with northern *M. undulatus*, and *M. furnieri* from the West Indies, do not seem to obtain. The point regarding the greater regularity of the oblique color-bars perhaps holds good, but these markings are fully as distinct as in *M. undulatus*.

The accompanying table shows the proportional measurements of our 9 specimens.

Proportional measurement of *Micropogon undulatus*.

| Total length in inches. | Head in length without caudal. | Eye in head. | Eye in inter-orbital. | Snout in head. | Pectoral in head. | Scales. | Dorsal.   | Anal. |
|-------------------------|--------------------------------|--------------|-----------------------|----------------|-------------------|---------|-----------|-------|
| 16.25                   | 3.18                           | 7.46         | 1.86                  | 3.39           | 1.33              | 7-56-12 | X, I, 29  | II, 8 |
| 15.50                   | 2.81                           | 7.52         | 1.80                  | 3.42           | 1.30              | 8-57-11 | X, I, 27  | II, 8 |
| 15.12                   | 3.33                           | 6.52         | 1.66                  | 3.26           | 1.30              | 7-57-12 | X, I, 27  | II, 8 |
| 12.75                   | 3.18                           | 5.68         | 1.50                  | 3.25           | 1.45              | 7-55-12 | X, I, 23  | II, 8 |
| 12.36                   | 3.25                           | 5.60         | 1.46                  | 3.50           | 1.42              | 7-53-12 | X, I, 24  | II, 8 |
| 12.25                   | 3.20                           | 5.52         | 1.46                  | 3.32           | 1.22              | 7-53-11 | X, I, 23  | II, 8 |
| 11.50                   | 3.26                           | 5.68         | 1.56                  | 3.37           | 1.45              | 7-53-11 | IX, I, 23 | II, 8 |
| 11.25                   | 3.43                           | 6.53         | -----                 | 3.10           | 1.31              | 8-52-11 | X, I, 23  | II, 8 |
| 10                      | 3.26                           | 6.54         | -----                 | 3              | 1.26              | 8-52-11 | X, I, 23  | II, 8 |

## Family PINGUIPEDIDÆ.

## 46. PINGUIPES SOMNAMBULA Berg.

## SALMÓN.

*Pinguipes somnambula* BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 61, "Mar del Plata, Oceanicus Atlantus costæ Provinciæ Bonaërensis."

One specimen, 24 inches long, which agrees very well with Berg's description.

Head 3.65 in length without caudal; eye 6.08 in head; snout 2.43; maxillary 2.21; mandible 2.14; D. V, 26, fifth spine longest, 4.56 in head, fourth ray longest, 2.51 in head; A. 24; pectoral 1.69, and ventral 1.62 in head; scales 16-102-26.

## Family PERCOPHIDÆ.

## 47. PERCOPHIS BRASILIENSIS Quoy and Gaimard.

## CONGRIO REAL.

*Percophis brasiliensis* QUOY and GAIMARD, Voy. Uranie, Zool., p. 351, 1824, Brésil.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 63 (coast of Patagonia; Bahía Blanca; Mar del Plata; Montevideo; Maldonado).

*Percophis fabre* QUOY and GAIMARD, Voy. Uranie, Zool., 1824, Atlas, pl. LIII, fig. 1.

*Percophis brasiliensis*, JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 23 ("Northern Patagonia, Maldonado").—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 616 ("Rio della Plata").—GÜNTHER, Challenger Rept., Zool., I, 1880, p. 13 (Mouth of the Rio de la Plata, 21 fathoms).

According to Berg this fish is common during the winter months, attaining a length of 70 cm. We have 2 specimens about 16 and 24 inches long, presenting the following proportional measurements respectively:

Head 4.05 and 4.16 in length without caudal; eye 9.1 and 9.35 in head and longer than interorbital width in one and 1.21 in this width in the other; snout 3.65 and 3.74 in head; maxillary 1.93 and 1.83; D. IX-31, the longest spine 2.67 and 3.27 in head; A. 40 and 37.

## Family TETRAODONTIDÆ.

## 48. LAGOCEPHALUS LÆVIGATUS (Linnæus).

*Tetraodon lævigatus* LINNÆUS, Syst. Nat., 12th ed., 1766, p. 411, Charleston, S. C.—PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, 2d ser., X (XXX), 1890-91, p. 657 (Montevideo).

*Lagocephalus lævigatus*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 82 (Montevideo; Maldonado).

According to Berg, the most southern point from which this species has been obtained is Montevideo, where many, from 25 to 30 cm. in

total length, have been collected. It appears to be present at all seasons of the year.

We have 2 specimens 12.75 and 13.5 inches in total length, respectively, from the market at Buenos Aires. The following notes were taken from these examples: Head about 3 in length, without caudal; depth 3.95; eye about 4.53 in head; snout 2.03; D. 14; A. 12.

### Family TRIGLIDÆ.

#### 49. PRIONOTUS PUNCTATUS (Bloch).

##### RUBIO.

*Trigla punctata* BLOCH, Syst. Ichth., 1793, pl. CCCLIII, Martinique.

*Prionotus punctatus*, JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 28 (Bay of Rio de Janeiro).—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1890, 72 (Mar del Plata; Montevideo).

Berg says that though not numerous in individuals this species occurs frequently in the places mentioned, and that it varies much in coloration, he having seen specimens of a very pronounced rosy hue, of a reddish gray, and of a clear plumbeous with more or less distinct black or brownish spots.

Six specimens in our collection, from the market at Buenos Aires, probably from Montevideo, having first been preserved in formalin and afterwards kept in alcohol, show almost uniformly the following pattern of coloration: Ground-color on back and sides, dark gray with some indistinct dark spots of various sizes, on some individuals having an appearance of crossbars; spinous dorsal transparent, whitish at base and near spines, sometimes with irregular, faint, dark lines; sometimes with a black margin in the membrane connecting the first 5 spines; second dorsal with 4 or 5 dark spots on each ray; pectoral dark bluish gray with large black spots along upper 6 rays and white between the spots, lower 7 rays with pale membrane between, bluish black on the rays with here and there thin washes or dashes of white.

In two specimens we count 95 scales, in the others 100 in longitudinal series. The dorsal formula is uniformly X, 12; the anal 10 in one specimen and 11 in all the others.

#### Proportional measurements of *Prionotus punctatus*.

| Total length in inches. | Head in length without caudal. | Eye in head. | Snout. | Maxillary. | Mandible. | Inter-orbital. | Pectoral in length without caudal. |
|-------------------------|--------------------------------|--------------|--------|------------|-----------|----------------|------------------------------------|
| 11.62                   | 2.74                           | 5.70         | 2.19   | 2.37       | 2.19      | 7.12           | 2.31                               |
| 10.50                   | 2.76                           | 6.25         | 2.17   | 2.27       | 2.00      | 6.25           | 2.22                               |
| 10.12                   | 2.85                           | 5.22         | 2.13   | 2.10       | 2.17      | 6.71           | 2.09                               |
| 10.00                   | 2.75                           | 6.00         | 2.08   | 2.28       | 1.84      | 6.85           | 2.23                               |
| 9.50                    | 2.77                           | 5.75         | 2.30   | 2.55       | 2.09      | 6.57           | 2.37                               |



## Family PLEURONECTIDÆ.

## 50. PARALICHTHYS PATAGONICUS Jordan and Goss.

*Paralichthys patagonicus* JORDAN and Goss, Rept. U. S. Fish Comm., XIV, 1886 (1889), p. 245, east coast of Patagonia.—BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 77 (Montevideo).

Regarding this species, Berg remarks that it is much less abundant than *P. brasiliensis* and is rather smaller, and that it is distinguished from the latter principally by the shorter gillrakers which are stouter and wider apart, 3 + 11 instead of 4 + 15; by the rather smaller maxillary teeth; eyes closer together; arch of lateral line lower; the salient point of the caudal fin; the body bespattered with small gray spots, and the pectoral bearing black transverse bands.

We have one specimen from the market at Buenos Aires. The total length is 12 inches; length without caudal 10.5 inches; depth 2.34 in length without caudal; head 3.8; eye 5.63 in head; snout about 4.78; maxillary 2.16; mandible 1.21; lengthwise series of scales about 100; dorsal, anal, and caudal scaly nearly throughout; D. 80, beginning opposite front of orbit; A. 65 or 66; teeth sharp, equally developed on both sides of each jaw, canine-like in front and smaller posteriorly; gillrakers 3 + 11.

## 51. ACHIRUS JENYNSI (Günther).

*Achirus lineatus*, JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 139 (Rio de la Plata).—VALENCIENNES in D'Orbigny's Voyage, 1847, p. 10, pl. xvi, fig. 2 (Cayenne); not of Linnæus.

*Solea jenkinsi* GÜNTHER, Cat., IV, 1862, p. 476, after Jenyns.—PERUGIA, Ann. Mus. Civ. Stor. Nat. Geneva, 2d ser., X (XXX), 1890-91, p. 628 (Belgrano e Rio de la Plata).

? *Achirus lorentzii* WEYENBERGH, Act. Acad. Nac. Cien. Cordova, III, 1877, p. 13, pl. 1.

Jordan and Goss include *Achirus lineatus* of D'Orbigny's Voyage, in the synonymy of *Achirus lineatus* Linnæus, which has a pectoral fin. *A. lineatus* of D'Orbigny has no pectoral fin and should therefore be referred to *A. jenkinsi*. Perugia has thus disposed of it. Perugia also states that, excepting some trifling difference, *Achirus lorentzii* Weyenbergh could be referred to *A. jenkinsi*, and he doubtfully places it in the synonymy of that species.

Two specimens in the present collection agree essentially with the description of *A. jenkinsi* as given by Jordan and Goss. Total length, respectively, about 7.25 and 5.75 inches. Head 3.63 and 3.37 in length without caudal; depth 1.61 and 1.49; snout 3.72 and 3.68 in head; interorbital 6.83 and 7.77; D. 58 and 61; A. 43 and 42; scales 85 or more.

52. *SYMPHURUS JENYNSI* Evermann and Kendall, new species.

*Plagusia*? JENYNS, Zool. Voy. Beagle, Pt. 4, Fish, 1842, p. 140, San Blas, coast of Patagonia.

? *Symphurus plagusia*, BERG, Anal. Mus. Nac. Buenos Aires, IV (2d ser., I), 1895, p. 79 (Mar del Plata; Montevideo).

Head 6.66 in length without caudal; depth 3.71; eye 13 in head; snout 4.33; D. 108; A. 93; C. 12; scales about 120.

Body outline nearly straight from about the first third of its total length to about the posterior two-fifths where it tapers to the base of the caudal, differing in this respect from *S. plagusia*, which begins to taper at about the anterior third of the length.

Teeth small, sharp, close-set, in several series in each jaw, on blind side; no teeth on upper side; eyes close together, about on same line, the lower, if either, slightly advanced; origin of dorsal fin about over front of upper eye.

Color (after preservation in formalin and later in alcohol), light yellowish brown, with faint darker streaks along the rows of the scales;

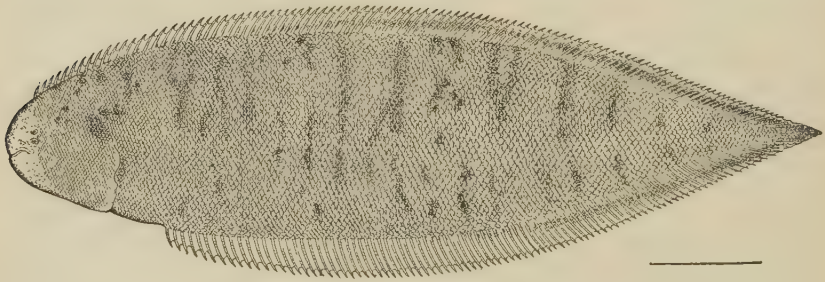


FIG. 4.—*SYMPHURUS JENYNSI*. (From the type.)

body also with cloudings and irregular, clouded crossbars; dorsal and anal dusky posteriorly, caudal dusky.

The single specimen in our collection differs greatly in several respects from *S. plagusia*, *brasiliensis*, *ornata*, *tesselata*, and all others that have been included in the synonymy of *S. plagusia*.

In shape and number of dorsal and anal rays our specimen resembles *S. nebulosus* (Goode and Bean<sup>a</sup>), but it differs from that species in having no teeth on the upper or eyed side. In *S. nebulosus* the teeth are said to be equally developed on both sides. In *S. nebulosus* the color is clouded, while in our specimen there are traces of clouded, irregular crossbands.

*Type*.—Cat. No. 55573, U.S.N.M., a specimen 7.18 inches long, probably from the market at Buenos Aires.

Named for Rev. Leonard Jenyns, an excellent naturalist, who wrote the report on the fishes collected by Charles Darwin during the memorable voyage of the *Beagle* around the world.

<sup>a</sup> *Aphoristia nebulosa* Goode and Bean, Bull. Mus. Comp. Zool., XI, No. 5, 1883, p. 192.

THE UROCOPTID MOLLUSKS FROM THE MAINLAND OF  
AMERICA IN THE COLLECTION OF THE UNITED STATES  
NATIONAL MUSEUM.

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By PAUL BARTSCH,

*Assistant Curator, Division of Mollusks*

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The United States National Museum has from time to time received additions to its collections of this group, some of which have been reported upon by Dr. R. E. C. Stearns,<sup>a</sup> Dr. William H. Dall,<sup>b</sup> and Dr. H. A. Pilsbry.<sup>c</sup>

By far the greater part of the material added in recent years was collected by Messrs. E. W. Nelson and E. A. Goldman in their explorations of Mexico, under the auspices of the Biological Survey of the United States Department of Agriculture. Dr. J. N. Rose and Mr. J. H. Painter, of the U. S. National Museum, and Dr. Edward Palmer have also made some interesting discoveries of mollusks in their botanical excursions in the same country. The very latest donations have come from Dr. H. Pittier, from Guatemala, and Prof. A. L. Herrera, from Mexico.

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The two new forms from the United States were collected by Drs. T. W. Stanton and T. Wayland Vaughan, of the United States Geological Survey, and Dr. Edward Palmer.

This report would be incomplete without mentioning my indebtedness to Dr. William H. Dall, Curator of the Division of Mollusks, for many kind suggestions, and to Dr. H. A. Pilsbry for critically comparing several forms with specimens in the Philadelphia Academy of Natural Sciences.

**EUCALODIUM DECOLLATUM Nyst.**

There are two specimens of this species in the collection, Cat. No. 186131, U.S.N.M., collected by E. W. Nelson and E. A. Goldman, at Teapa, Tabasco, Mexico.

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<sup>a</sup> Proc. U. S. Nat. Mus., XIII, 1890, pp. 208-211; XIV, 1891, p. 100.

<sup>b</sup> Nautilus, IX, 1895, No. 5; Proc. U. S. Nat. Mus., XVIII, 1895, pp. 3-5; XIX, 1896, pp. 344-357; Smith Misc. Coll. (Quart. Issue), XLVIII, 1905, pp. 187-190.

<sup>c</sup> Manual of Conchology, XV, 1903; XVI, 1904.

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## EUCALODIUM DECOLLATUM GUATEMALENSIS, new subspecies.

Plate III, fig. 9.

*Eucalodium decollatum* FISCHER AND CROSSE (in part), Miss. Scient. Mexique, p. 363, pl. xiv, figs. 3 and 3a; not *Eucalodium decollatum* NYST.

Shell subcylindric, truncated, strong, of light reddish chocolate color. Plug convex and granulose. Whorls ten and one-fourth, moderately rounded, increasing gently in size, marked by many poorly defined, irregular, wavy, thread-like riblets, which are best developed on the posterior whorls. Sutures well marked. Periphery of the last whorl angulated. Base short, of lighter color than the spire, well rounded, showing a strongly impressed umbilical chink, but no perforation. Aperture oblique, suboval; peristome continuous, free, decidedly expanded, and somewhat reflected, white; columella somewhat curved, obsoletely truncated below. Aperture smoky white within. Internal pillar with a strong, smooth, spiral fold.

The type, Cat. No. 162307, U.S.N.M., was collected in Guatemala by Godman and measures: Length, 60.9 mm.; diameter of penultimate whorl, 17.5 mm.; greatest diameter of aperture, from the posterior angle to the angle at junction of outer lip and columella, 15 mm.

This subspecies appears to agree well with the form cited by Fischer and Crosse as *E. decollatum* Nyst. The true *E. decollatum* Nyst is a much larger form. *E. decollatum guatemalensis* has the color of the form known as *ghiesbreghtii* Pfeiffer. In the structure of the internal axis it agrees with *E. decollatum*. In *guatemalensis*, however, the lamella is a little less strongly developed.

## EUCALODIUM MEXICANUM MAJOR Fischer and Crosse.

There is one specimen, Cat. No. 162500, U.S.N.M., in the collection from Guatemala, donated by Dr. H. von Ihering. This has 10 whorls remaining, which measure: Length, 65 mm.; diameter of penultimate whorl, 16.8 mm.

## EUCALODIUM (OLIGOSTYLUS) BLANDIANUM Fischer and Crosse.

There are five specimens of this form in the collection. Two, Cat. No. 25029, U.S.N.M., labeled, Mexico. Two, Cat. No. 23787, U.S.N.M., Eastern Mexico with a ? and one, Cat. No. 10526, U.S.N.M., Orizaba, Mexico. The last was collected by G. Strebel, in 1866.

## EUCALODIUM (OLIGOSTYLUS) BLANDIANUM MINOR Fischer and Crosse.

There are three specimens of this subspecies in the collection, Cat. Nos. 185932 and 185933, U.S.N.M., all from Aculzintgo, Vera Cruz, Mexico, presented by Prof. A. L. Herrera. One of these is a young



individual. The two adults have  $8\frac{1}{2}$  and 9 whorls remaining, and measure: Length, 72.3 mm. and 67.8 mm.; diameter of penultimate whorls, 18.4 mm. and 17.3 mm., respectively.

**EUCALODIUM (OLIGOSTYLUS) WALPOLEANUM** Fischer and Crosse.

There are three lots of this species in the collection, Cat. No. 32078, two specimens collected by F. Sarg, with the locality label Guatemala. Two, Cat. No. 162308, U.S.N.M., from Coban, Guatemala, collected by Godman, and one, Cat. No. 117157, U.S.N.M., collected at the last locality by C. M. Wheatley. The last two have a decidedly stronger spiral sculpture and are also of lighter color than the preceding three specimens. There are two oval white eggs with Cat. No. 32078, U.S.N.M., which have the entire surface uniformly granulose and measure: Length, 5.8 mm.; diameter, 3.5 mm. The five shells measure:

*Measurements of Eucalodium (Oligostylus) walpoleanum.*

| Cat. No. | Number of remaining whorls. | Length. | Diameter of penultimate whorl. |
|----------|-----------------------------|---------|--------------------------------|
|          |                             | mm.     | mm.                            |
| 32078    | $9\frac{1}{2}$              | 76.3    | 19.3                           |
| 32078    | $9\frac{1}{2}$              | 64      | 17                             |
| 162308   | $9\frac{1}{2}$              | 71.7    | 18                             |
| 162308   | 10                          | 76.6    | 17                             |
| 117157   | $11\frac{1}{2}$             | 76.4    | 18.2                           |

**EUCALODIUM (OLIGOSTYLUS) HIPPOCASTANEUM** Dall.

The type and two specimens, Cat. No. 186137, U.S.N.M., collected by E. W. Nelson, at San Sebastian, Jalisco, Mexico. The type has  $6\frac{1}{2}$  whorls and measures: Length, 19 mm.; diameter of penultimate whorl, 9.7 mm. The other two have 8 and  $7\frac{1}{4}$  whorls, respectively, and measure: Length, 31.1 mm., and 29.1 mm.; diameter of penultimate whorl, 10 mm. and 9.4 mm.

**EUCALODIUM (OLIGOSTYLUS) DENSECOSTATUM** Strebel.

Two specimens, Cat. No. 73877, U.S.N.M., collected by the Geographic Commission at Mizantla, Mexico. These specimens have 9 and 8 whorls, respectively, and measure: Length, 38.3 mm. and 35.8 mm.; the diameter of penultimate whorls in both cases is 10.4 mm.

**EUCALODIUM (OLIGOSTYLUS) SPECIOSUM BOUCARDI** Pfeiffer.

There are two specimens of this form in the collection, Cat. No. 25033, U.S.N.M., labeled Mexico. The largest has  $9\frac{1}{4}$ , the other  $8\frac{3}{4}$  whorls. They measure: Length, 52.9 mm., and 48.7 mm.; their penultimate whorls have a diameter of 8.1 mm., and 7.3 mm., respectively.

**EUCALODIUM (OLIGOSTYLUS) SPECIOSUM STREBELI** von Martens.

There is one specimen in the collection of this form, Cat. No. 10828, U.S.N.M., which has 9 whorls and measures: Length, 44.6 mm.; diameter of antipenultimate whorl, 11 mm. The locality given is Veracruz?, Mexico.

**EUCALODIUM (OLIGOSTYLUS) CEREUM** Strebel.

The collection contains one specimen of this species, Cat. No. 25033a, U.S.N.M., labeled Mexico. It has 9 whorls remaining which measure: Length, 37.3 mm.; diameter of antipenultimate whorl, 10.3 mm. The fine spiral striations between the sinuous, oblique, closely placed thread-like riblets are well marked.

**ANISOSPIRA DALLI** von Martens.

There are twelve adult shells and three apices of this species in the collection, all but one collected by E. W. Nelson at the type locality, Huilotepec, Oaxaca, Mexico. One specimen donated by Bland, Cat. No. 58055a, U.S.N.M., is said to have come from near Mazatlan. The ten perfect specimens from the type locality measure:

*Measurements of Anisospira dalli.*

| Cat. No.                  | Number of whorls. | Length.    | Diameter of penultimate whorl. | Diameter, fourth to last whorl. | Diameter of first whorl. |
|---------------------------|-------------------|------------|--------------------------------|---------------------------------|--------------------------|
|                           |                   | <i>mm.</i> | <i>mm.</i>                     | <i>mm.</i>                      | <i>mm.</i>               |
| 107366 <sup>a</sup> ..... | 8.2               | 29.3       | 9.1                            | 10.3                            | 5.8                      |
| 107366 .....              | 9                 | 32.6       | 9                              | 10.5                            | 7                        |
| 107366 .....              | 8.5               | 31.3       | 10.6                           | 11                              | 6                        |
| 107366 .....              | 8                 | 29.2       | 10.2                           | 11.2                            | 6.5                      |
| 107366 .....              | 8.2               | 29.6       | 10                             | 10.8                            | 6                        |
| 107366 .....              | 7.5               | 29.3       | 9.7                            | 10.8                            | 6.9                      |
| 107366 .....              | 7.2               | 28         | 10                             | 10.8                            | 6.6                      |
| 107366 .....              | 7                 | 26         | 10.5                           | 10.6                            | 6.6                      |
| 107366 .....              | 7.2               | 27.2       | 10.2                           | 11.3                            | 7.7                      |
| 107366 .....              | 8.2               | 29.7       | 9.5                            | 9.9                             | 6                        |
| Average .                 | 7.9               | 29.22      | 9.88                           | 10.72                           | 6.31                     |

<sup>a</sup> Type.

Two of the decollated apices measure:

*Apex measurements of Anisospira dalli.*

| Number of whorls. | Third whorl from apex. | Fifth whorl from apex. | Tenth whorl from apex. | Fourteenth whorl from apex. |
|-------------------|------------------------|------------------------|------------------------|-----------------------------|
|                   | <i>mm.</i>             | <i>mm.</i>             | <i>mm.</i>             | <i>mm.</i>                  |
| 15 .....          | 3.15                   | 3                      | 4.5                    | 5.5                         |
| 11 .....          | 3.2                    | 3                      | 5.1                    | .....                       |

**ANISOSPIRA STREBELI** Pfeffer.

There are three specimens of this species in the collection, Cat. No. 162306, U.S.N.M., collected by Godman at Cerro de Plumes, Oaxaca, Mexico.

*Measurements of Anisospira strebeli.*

| Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of fourth to last whorl. | Diameter of first whorl. |
|-------------------|---------|--------------------------------|-----------------------------------|--------------------------|
|                   | mm.     | mm.                            | mm.                               | mm.                      |
| 7.9               | 42.7    | 13                             | 13.4                              | 7                        |
| 7.9               | 38.3    | 13.4                           | 13.7                              | 6.7                      |
| 7.9               | 38.8    | 12.1                           | 13.3                              | 7                        |

**DISSOTROPIS**, new subgenus.

Exterior of decollated spire agreeing with *Anisospira*. Columella provided with a strong spiral lamella which is situated a little above the floor and a weaker twist or low fold posterior to this. Lamella in the antepenultimate whorl cut by a series of regularly spaced, oblique, forward-slanting slits.

*Type*.—*Anisospira (Dissotropis) stearnsi*, new species.

**ANISOSPIRA (DISSOTROPIS) STEARNSI**, new species.

Plate III, fig. 1.

Shell subcylindric, milk white. Plug convex, covered on its inner half by rather large granules, outer half evenly, very finely granulose. Exposed columella at the decollated end slightly sigmoid. Whorls moderately convex, angular at the periphery which slightly overhangs the summit of the succeeding whorls, marked by many very regular and regularly spaced obliquely, slanting riblets which are about as wide as the interspaces. There are about 120 riblets on the third to last whorl. Periphery of the last whorl angular, the angle becoming less marked behind the outer lip. Base imperforate, very short, and moderately rounded at the junction of the columellar margin with the preceding whorl, becoming gradually longer and more inflated from there on to the peristome, marked by the continuation of the riblets, which are somewhat flexed and thickened at the periphery and become attenuated and very much crowded toward the umbilicus. Aperture subcircular, bordered by a cord-like, white peristome, which has the appearance on the inside as if it had been melted and flowed over the adjoining wall; columellar folds visible in the aperture, but very weakly developed at this point. In the interior the columella is slender, and provided with a weak, median flexure, which extends throughout the shell, and a strong, spiral lamella. The latter extends through the last five whorls only and is largest in the penultimate whorl, tapering

abruptly anteriorly and more gradually posteriorly. The insertion of this lamella is near the floor of the whorl; from that point it curves upward and outward, then again downward at the free edge. The latter in the penultimate whorl is at about one-third of the distance between the floor and the roof above the floor, and extends about one-third the way across from the columella to the wall. In the penultimate whorl the lamella is thickened at regular intervals on its upper surface, lending to this a somewhat beaded effect. These thickenings are not very prominent but rather low and broad. In the antipenultimate whorl the lamella is cut by a series of regularly spaced, obliquely forward curved slits, which extend about one-third of the way from the periphery of the lamella toward its insertion. The type, Cat. No. 186164, U.S.N.M., was obtained by Dr. R. E. C. Stearns from Bland

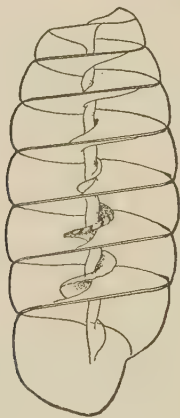


FIG. 1.—INTERIOR VIEW OF  
*ANISOSPIRA STEARNSI*.

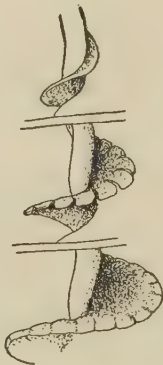


FIG. 2.—DETAIL OF PILLAR OF  
*ANISOSPIRA STEARNSI*.

and is said to come from near Mazatlan. It has 7 whorls and measures: Length, 30 mm.; diameter of penultimate whorl, 11.6 mm.; diameter of fourth to last whorl, 12.5 mm.; diameter of first whorl, 7 mm.

***ANISOSPIRA (DISSOTROPIS) BLANDI*, new species.**

Plate III, fig. 3.

Shell subcylindric from the last to the seventh to last whorl, the next two evenly and suddenly contracted, the first is less sloping, and lends the spire a capped appearance. Decollated apex very minutely punctured. Plug evenly, finely granulose. Whorls moderately rounded, marked by numerous, equally developed and evenly spaced, low rounded, obliquely backward curved thread-like riblets, of which about 120 occur upon the fourth to last whorl. The spaces between these riblets are a little less than twice as wide as the riblets. Sutures well impressed. Periphery of the last whorl angular. Base somewhat



pinched immediately anterior to the periphery, which renders this area slightly concave; the rest of the base well rounded and marked by the riblets, which are rendered somewhat sinuous in passing over the periphery and the depressed area. Aperture not entirely completed in our specimen, showing the almost obsolete fold. Internal pillar thin in the last whorl, gradually increasing in diameter to 2.3 mm. in the third to last volution, diminishing from there to the decollated apex. The pillar has a spiral twist running throughout the spire a little posterior to the middle, and a spiral lamella, which is inserted

on the columella, a little above the floor. This fold is almost obsolete in the last whorl, growing gradually stronger posteriorly. It attains its maximum development in the antepenultimate volution, where it extends almost one-third of the way across the inside of the whorl; from this point it gradually diminishes in size and disappears altogether in the sixth to last volution. In the third and fourth to last volution the lamella is incised at regular intervals by slits, which extend about one-sixth of the way from the edge to the insertion of the columella. The type and only specimen, Cat. No. 58055, U.S.N.M., was obtained from Mr. Bland by Dr. Stearns, and is said to come from near Mazatlan. It has 9.1

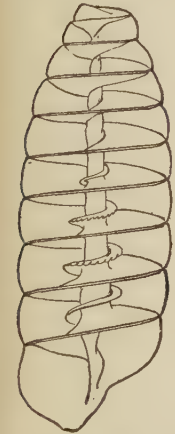


FIG. 3.—INTERIOR VIEW OF ANISOSPIRA BLANDI.



FIG. 4.—DETAIL OF PILLAR OF ANISOSPIRA BLANDI.

whorls which measure: Length, 33.7 mm.; diameter of penultimate whorl, 11.5 mm.; diameter of fifth to last whorl, 12 mm.; diameter of first whorl, 6.1 mm.

The present species is a somewhat puzzling form; the puncture at the decollated apex and inflated pillar would place it in *Coelocentrum*, but the peculiar sculpture of the lamella allies it closely to *Anisospira* (*Dissotropis*) *stearnsi*.

#### CŒLOCENTRUM NELSONI Dall.

There are two lots of this species in the collection, the type, Cat. No. 107368, U.S.N.M., and four other specimens, Cat. No. 185902, U.S.N.M., collected by E. W. Nelson and E. A. Goldman, respectively, at Tuxtla Gutierrez, Chiapas, Mexico.

The specimens measure:

*Measurements of Cœlocentrum nelsoni.*

| Cat. No.            | Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of fourth to last whorl. | Diameter of first whorl. |
|---------------------|-------------------|---------|--------------------------------|-----------------------------------|--------------------------|
|                     |                   | mm.     | mm.                            | mm.                               | mm.                      |
| 107368 <i>a</i> ... | 9.1               | 52.1    | 17.4                           | 17.3                              | 9.1                      |
| 185902. ....        | 9.9               | 55      | 17.6                           | 18.2                              | 9.3                      |
| 185902. ....        | 8.3               | 49.5    | 16.8                           | 17.3                              | 10                       |
| 185902. ....        | 8                 | 45      | 16.4                           | 16.5                              | 10.5                     |
| 185902. ....        | <i>b</i> 4        | 30.4    | 16.2                           | 16.5                              |                          |

*a* Type.

*b* The last four.

**CŒLOCENTRUM PFEFFERI** Dall.

There are four specimens and two fragments of this species in the collection, Cat. No. 107367, U.S.N.M., all from Ocozocuantla, Chiapas, Mexico.

*Measurements of Cœlocentrum pfefferi.*

| Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of fourth to last whorl. | Diameter of first whorl. |
|-------------------|---------|--------------------------------|-----------------------------------|--------------------------|
|                   | mm.     | mm.                            | mm.                               | mm.                      |
| <i>a</i> 8.5      | 43.1    | 15.8                           | 15.7                              | 8.1                      |
| 8.1               | 44.5    | 15.7                           | 15.2                              | 8.5                      |
| 8.5               | 42.7    | 15.5                           | 15                                | 8.3                      |
| 7.8               | 38.7    | 15.4                           | 13.7                              | 7.7                      |

*a* Type.

**CŒLOCENTRUM PITTIERI**, new species.

Plate III, fig. 7.

Shell elongate conic, turrit, with truncated summit, light brown on the spire, and whitish on the base. The shell attains its greatest diameter in the fourth to last whorl, from which it tapers gradually to the ninth to last; the four whorls preceding this are of almost the same caliber. Plug evenly and minutely granulose. Puncture round, small. Whorls moderately rounded, marked by many quite regular, very narrow and acute, obliquely backward slanting riblets, which are less than half as wide as the spaces between them. These riblets are best developed on the posterior half of the spire; on the anterior half they are less regular, less acute, and much more distantly spaced. On the fifth to last whorl I counted 8 riblets to a space of 2 mm., while on the penultimate whorl only half that number were present. The spaces between the riblets and the sides of the riblets display a fine crinkling, which almost amounts to closely spaced spiral markings. Sutures well marked. Periphery of the last whorl marked by a small thread-like angulation; the space immediately anterior to

this is somewhat sunk, lending it the appearance of a broad, shallow groove. The remainder of the base is well rounded and marked by the continuation of the riblets which pass undiminished over the periphery and the groove to the umbilical region, where they become decidedly crowded. Last whorl free for about  $1\frac{1}{2}$  mm. Aperture suboval, somewhat angulated at the posterior lateral margin and at the junction of the columellar edge and the lip, showing the edge of the obsoletely truncated pillar within. Peristome yellowish white, somewhat thickened, decidedly expanded but not reflected. Internal pillar, 2.5 mm. in diameter in its widest part, provided with a thickened twist in each whorl about one-fourth the height of the whorl above its base. In addition to this the pillar is marked, posterior to the twist, by irregularly developed, low, rounded, smooth, cord-like, oblique folds or threads; in most instances these are not continuous, but are interrupted, forming a series of low, oval, or elongated protuberances. The space anterior to the twist is smooth. There are two specimens of this species in the collection of the U. S. National Museum Cat. No. 185492, collected by Dr. H. Pittier in the Cave of Sakalkunte, near Senahu, Alta Vera Paz, Guatemala at an altitude of 1,800 meters.

*Measurements of Cœlocentrum pittieri.*

| Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of fourth to last whorl. | Diameter of apex. |
|-------------------|---------|--------------------------------|-----------------------------------|-------------------|
|                   | mm.     | mm.                            | mm.                               | mm.               |
| α 12.7            | 60.7    | 14.8                           | 14.9                              | 7.1               |
| 12.7              | 64.2    | 16.2                           | 16.8                              | 7                 |

α Type.

Aperture of type from angle to angle, 13 mm., the line at right angles to the center of the above measurement, 10.1 mm.

These two specimens are in a semifossil state, and partly incrustated with lime deposits. The left border of the figure is slightly obscured by the deposit in our illustration. The shell superficially has the general aspect of *Cœlocentrum turris* Pfeiffer, but differs markedly from this by its much smaller internal pillar and the sculpture thereof.

**CŒLOCENTRUM PITTIERI GUATEMALENSIS**, new subspecies.

Plate IV, fig. 11.

There is one specimen in the collection, Cat. No. 187469, U.S.N.M., collected by Dr. H. Pittier at Secanquim, Alta Vera Paz, Guatemala, at an altitude of 550 meters, which agrees most nearly with *C. pittieri*, but differs sufficiently to merit a distinct name. It differs from *C. pittieri* by its smaller size and less tapering early whorl, and by having the riblets more distantly spaced. The whorls, too, are slightly over-

hanging, giving rise to channeled sutures. The internal column differs from *C. pittieri* in having much more regular lamellæ, which are rarely interrupted. Between these lamellæ there appear irregularly rounded nodules and elongate tubercles. The base of the pillar is smooth below the twist in each whorl, as in *pittieri*.

The type has 9.9 whorls and measures: Length, 41.8 mm.; diameter of penultimate whorl, 14 mm.; diameter of fourth to last whorl, 14.3 mm.; diameter of first whorl, 7 mm.

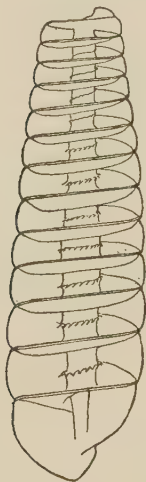


FIG. 5.—INTERIOR VIEW OF CŒLOCENTRUM ASTROPHOREA.

**PTYCHODONTA**, new subgenus.

Shell with the exterior aspect of *Coelocentrum* ss. Internal pillar about one-third the diameter of the inside of the shell, thin, crossed by many thin, obsolete, oblique lamellæ. The pillar bears a moderately strong spiral lamella situated a little below the middle in each whorl, from which a series of slender, curved teeth project outward and forward into the cavity.



FIG. 6.—a, PILLAR OF THE THIRD AND FOURTH TO LAST WHORL OF CŒLOCENTRUM ASTROPHOREA; b, THE PILLAR OF THE PENULTIMATE WHORL OF CŒLOCENTRUM ASTROPHOREA.

In the penultimate whorl and the early whorls these teeth give place to broad, triangular spines, which gained the name *astrophorea* for the type species.

**CŒLOCENTRUM (PTYCHODONTA) ASTROPHOREA** Dall.

There are four specimens and two fragments of this form in the collection, Cat. No. 134696, U.S.N.M., collected by E. W. Nelson at Encarnacion, Hidalgo, Mexico.

*Measurements of Cœlocentrum (Ptychodonta) astrophorea.*

| Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of seventh to last whorl. | Diameter of first whorl. |
|-------------------|---------|--------------------------------|------------------------------------|--------------------------|
|                   | mm.     | mm.                            | mm.                                | mm.                      |
| a 15              | 29.8    | 7                              | 7.3                                | 4.2                      |
| 13                | 28.3    | 7                              | 7.5                                | 5                        |
| 13                | 28      | 7                              | 7.6                                | 5.1                      |
| 13                | 26.8    | 7.1                            | 7.7                                | 4.9                      |

a Type.



## CÆLOCENTRUM (SPARTOCENTRUM) IRREGULARE Gabb.

There are two specimens of this species in the collection, Cat. No. 107326, U.S.N.M., donated by the author. They are part of the type lot, which was collected at Mulege, Lower California. Both are decolated.

*Measurements of Cælocentrum (Spartocentrum) irregulare.*

| Number of whorls remaining. | Length.     | Diameter of penultimate whorl. | Diameter of fifth to last whorl. |
|-----------------------------|-------------|--------------------------------|----------------------------------|
| 8.1                         | mm.<br>14.8 | mm.<br>4.3                     | mm.<br>4.5                       |
| 7                           | 14.5        | 4                              | 3.8                              |

## CÆLOCENTRUM (SPARTOCENTRUM) MINORINUM GABBII Pilsbry.

There are two lots of this form in the collection of the U. S. National Museum, one, two specimens, Cat. No. 57934, U.S.N.M., is part of the type lot collected by W. M. Gabb at Mulege, Lower California; the other, Cat. No. 187484, U.S.N.M., collected by E. W. Nelson and E. A. Goldman at Guajadami, Lower California, contains sixteen specimens, eight of which are perfect. The following table gives a list of measurements:

*Measurements of Cælocentrum (Spartocentrum) minorinum gabbii.*

| Cat. No.    | Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of fifth to last whorl. | Diameter of second whorl. |
|-------------|-------------------|---------|--------------------------------|----------------------------------|---------------------------|
|             |                   | mm.     | mm.                            | mm.                              | mm.                       |
| 187484..... | 20                | 29.1    | 4.6                            | 4.6                              | 1.6                       |
| 187484..... | 17                | 25      | 4.6                            | 4.3                              | 1.6                       |
| 187484..... | 17                | 26      | 4.5                            | 4.5                              | 1.7                       |
| 187484..... | 18                | 26.4    | 4.5                            | 4.3                              | 1.7                       |
| 187484..... | 20                | 28.7    | 4.8                            | 4.6                              | 1.7                       |
| 187484..... | 17                | 25.3    | 4.8                            | 4.5                              | 1.8                       |
| 187484..... | 18                | 25.3    | 4.5                            | 4.3                              | 1.7                       |
| 187484..... | 19                | 26      | 4.5                            | 4.3                              | 1.7                       |
| Average..   | 18.25             | 26.4+   | 4.6                            | 4.4+                             | 1.68                      |
| Largest..   | 20                | 29.1    | 4.8                            | 4.6                              | 1.8                       |
| Smallest..  | 17                | 25      | 4.5                            | 4.3                              | 1.6                       |
| 57934.....  | 16                | 23.6    | 4.1                            | 4.3                              | 1.5                       |
| 57934.....  | 16                | 23.6    | 4.2                            | 4.2                              | 1.5                       |

The Guajadami specimens appear uniformly a little larger than our specimens from Mulege.

## CÆLOCENTRUM (SPARTOCENTRUM) EISENI Pilsbry.

There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 160503, collected by G. Eisen at Cape St. Lucas, Lower California, and presented to the Museum by

Fred Button. One of these specimens is complete, the other has the apex decollated.

*Measurements of Celocentrum (Spartocentrum) eiseni.*

| Number of whorls. | Length.     | Diameter of penultimate whorl. | Diameter of sixth to last whorl. | Diameter of nucleus. |
|-------------------|-------------|--------------------------------|----------------------------------|----------------------|
| 23                | mm.<br>26.3 | mm.<br>3.6<br>3.6              | mm.<br>3.7<br>3.8                | mm.<br>1.4           |

**BERENDTIA TAYLORI** Pfeiffer.

There are three specimens of this species in the collection of the U. S. National Museum. Two, Cat. No. 58653, U.S.N.M., from Mulege, Lower California, and the other, Cat. No. 160118, U.S.N.M., Lower California, without specific locality.

**EPIROBIA POLYGYRA** Pfeiffer.

There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 162319, U.S.N.M., collected by Godman, at Cordoba, Mexico.

*Measurements of Epirobia polygyra.*

| Number of whorls. | Length.     | Diameter of penultimate whorl. | Diameter of tenth whorl. | Diameter of apex. |
|-------------------|-------------|--------------------------------|--------------------------|-------------------|
| 26                | mm.<br>18.3 | mm.<br>2.3                     | mm.<br>1.2               | mm.<br>0.6        |
| 25                | 18.8        | 2.4                            | 1.4                      | 0.7               |

**EPIROBIA POLYGYRELLA** von Martens.

There are three specimens of this species in the collection of the U. S. National Museum, Cat. No. 162318, U.S.N.M., collected by Godman, at Coban, Guatemala.

*Measurements of Epirobia polygyrella.*

| Number of whorls. | Length.     | Diameter of penultimate whorl. | Diameter of eighteenth whorl. | Diameter of apex. |
|-------------------|-------------|--------------------------------|-------------------------------|-------------------|
| 23                | mm.<br>14.8 | mm.<br>2                       | mm.<br>2.3                    | mm.<br>0.8        |
| 21                | 13.2        | 2.2                            | 2.3                           | 0.8               |
| 22                | 13.9        | 2                              | 2.3                           | 0.8               |

## EPIROBIA COAHUILENSIS, new species.

Plate IV, fig. 3.

Shell small, subulate-conic, light horn yellow. Nuclear whorls three, moderately inflated, smooth, forming a cylindrical tip. Succeeding whorls very low between the sutures, moderately rounded, ornamented by many, very regular and regularly spaced, decidedly sigmoid, thread-like riblets, which are about one-half as wide as the spaces that separate them. I counted fifteen in the space of 1 millimeter. The sigmoid curve of the riblets is better expressed on the later whorls than on the early ones. Some of the riblets are white and this lends the spire a somewhat mottled appearance. Sutures well impressed. Periphery of the last whorl decidedly angular, base very short, almost flattened, widely umbilicated, marked by the continuations of the ribs, which extend into the umbilicus. Last whorl shortly free, having the parietal wall of the aperture projecting for a short distance beyond the penultimate whorl. (Aperture fractured in the type.) Internal column without twist or fold, large, fully one-third the width of the entire shell, thin, translucent, concave in the center of each whorl, broadening toward both ends, crossed by rather distant, thread-like, axial riblets.

The two specimens in the U. S. National Museum collection, Cat. No. 187505, were collected by E. W. Nelson in the Sierra Guadalupe, Coahuila, Mexico. They are not quite adult and it is possible that fully adult specimens may show less of the umbilicus, or may have it completely closed, as in the other known *Epirobia*. The free last whorl of the type, however, argues against this.

*Measurements of Epirobia coahuilensis.*

| Number of whorls. | Length. | Diameter of second whorl. | Diameter of tenth whorl. | Diameter of twentieth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|---------------------------|--------------------------|------------------------------|--------------------------------|
|                   | mm.     | mm.                       | mm.                      | mm.                          | mm.                            |
| a 23              | 10.8    | 0.7                       | 1.8                      | 2.9                          | 2.7                            |
| 22                | 9.5     | 0.7                       | 1.8                      | 2.9                          | -----                          |

a Type.

## PROPILSBRYA, new subgenus.

Exterior of shell, like *Epirobia*. Internal column slender, hollow throughout, having a somewhat submedian thread-like fold, which extends over the entire length of the axis. In several of the whorls preceding the last, this fold becomes very much enlarged, forming a strong, spiral lamella. The parietal wall is furnished with a narrow band-like lamella, which is pendant from the roof, and extends throughout the spire; in the three whorls preceding the penultimate,

this band bears small, forward-slanting teeth, the whole resembling the blade of a narrow saw.

Type.—*Epirobia* (*Propilsbrya*) *nelsoni*, new species.

**EPIROBIA (PROPILSBRYA) NELSONI, new species.**

Plate IV, fig. 8.

Shell subulate, horn colored with white riblets. Nuclear whorls two and one-half, somewhat inflated, smooth under ordinary magnification, but very minutely granulose when viewed under the compound microscope. Later whorls well rounded, crossed by many slender, quite

regular, obliquely curved riblets, which are about one-third as wide as the spaces between them. The riblets are less developed on the early whorls than in the middle of the spire; in the middle I counted 11 in the space of 1 millimeter. They are strongest on the penultimate whorl, where only 8 were counted in the space of 1 millimeter. Periphery of the last whorl somewhat angulated, the angulation becoming less

apparent toward the aperture. Base rounded, pierced by the small open umbilicus and marked by the continuation of the ribs which extend over it and into the umbilicus. Last whorl solute for about  $1\frac{1}{4}$  mm. Parietal wall of the solute portion decidedly pinched at about one-third of the way to the left of the posterior lateral angle, which lends the parietal wall a sinuous aspect. The solute portion of the parietal wall is crossed by the continuation of the ribs of the outer wall.

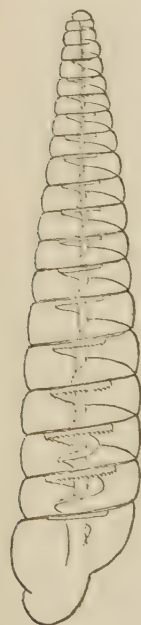


FIG. 7.—INTERIOR VIEW OF *EPIROBIA NELSONI*.

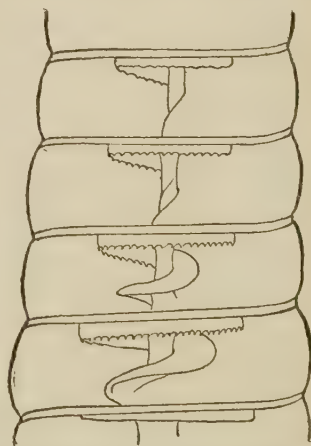


FIG. 8.—DETAIL OF INTERIOR OF *EPIROBIA NELSONI*.

Aperture semi-oval, the parietal wall representing the short diameter of the oval, angulated at the posterior lateral margin and at the junction of the columella and parietal wall; well rounded anteriorly, showing the weak parietal fold within. Peristome moderately effuse, but not revolute. Internal column slender, perforate, having a somewhat submedian thread-like fold, which extends throughout the entire spire. In the antipenultimate and penultimate whorl, this fold becomes very much enlarged, forming a strong lamella, which extends one-fourth of the way across the space between the pillar and the wall. This lamella tapers very rapidly both anteriorly and posteriorly. Transverse septa thin, trans-



parent, marked by a narrow spiral lamella, which is pendant almost from the middle of the roof of the whorls and extends throughout the entire spire. In the three whorls preceding the penultimate whorl this lamella is furnished with slender, forward-slanting teeth, the whole, in this part, resembling the blade of a narrow saw. There are two specimens of this species in the U. S. National Museum collection, Cat. No. 187504, and one in the Academy of Natural Science, Philadelphia, all collected by E. W. Nelson in the Sierra Guadalupe, Coahuila, Mexico.

*Measurements of Epirobia (Propilsbrya) nelsoni.*

| Number of whorls. | Length. | Diameter of second whorl. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|---------------------------|--------------------------|--------------------------------|
|                   | mm.     | mm.                       | mm.                      | mm.                            |
| 20                | 15.2    | 9                         | 1.9                      | 3                              |
| 22                | 18      | 9                         | 1.9                      | 2.9                            |

a Type.

The second specimen has the strong fold on the pillar, extending over the four whorls preceding the penultimate.

**HOLOSPIRA (HOLOSPIRA) GOLDFUSSI Menke.**

and

**HOLOSPIRA (HOLOSPIRA) GOLDFUSSI ANACACHENSIS, new subspecies.**

Plate IV, fig. 4.

The members of this species in our collection group themselves about two centers of distribution. One of these centers, that of the typical form, is New Braunfels; the other has its center in the Anacacha Mountains. The two forms agree quite well in size, as is shown in the accompanying table of measurements. The western form has a lesser number and much more strongly developed ribs than typical *goldfussi* (see table), and may be known as *Holospira (Holospira) goldfussi anacachensis* (see table).

*Measurements of Holospira (Holospira) goldfussi.*

| Cat. No.       | Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of tenth whorl. | Locality.        | Collector.        |
|----------------|-------------------|---------|--------------------------------|--------------------------|------------------|-------------------|
| 8693.....      | 15                | mm.     | mm.                            | mm.                      | Blanco River.... | B. F. Shumard.    |
| 26554.....     | 15                | 13.3    | 3.2                            | 3.8                      | do.....          | Do.               |
| Average.....   | 15                | 13.25   | 3.1                            | 3.8                      |                  |                   |
| 58020.....     | 14                | 13.2    | 3.3                            | 3.8                      | San Marcos.....  | R. E. C. Stearns. |
| 58020.....     | 14                | 13.1    | 3.2                            | 3.8                      | do.....          | Do.               |
| 58020.....     | 13                | 11.6    | 3.2                            | 3.8                      | do.....          | Do.               |
| Average.....   | 13.66             | 12.63   | 3.23                           | 3.8                      |                  |                   |
| 123753.....    | 13                | 12.5    | 3.4                            | 3.9                      | New Braunfels..  | Gurley.           |
| 123753.....    | 14                | 13.3    | 3.5                            | 4.2                      | do.....          | Do.               |
| 123753.....    | 13                | 12.3    | 3.3                            | 3.9                      | do.....          | Do.               |
| 123753.....    | 14                | 12.8    | 3.3                            | 3.8                      | do.....          | Do.               |
| 123753.....    | 13                | 12.3    | 3.7                            | 4.2                      | do.....          | Do.               |
| 123753.....    | 13                | 12.3    | 3.2                            | 3.9                      | do.....          | Do.               |
| 123753.....    | 14                | 13.1    | 3.2                            | 3.9                      | do.....          | Do.               |
| 97450.....     | 13                | 13.3    | 3.5                            | 4.3                      | do.....          | J. A. Singley.    |
| 97450.....     | 13                | 12.5    | 3.5                            | 4                        | do.....          | Do.               |
| 97450.....     | 13                | 12.3    | 3.2                            | 3.8                      | do.....          | Do.               |
| 97450.....     | 13                | 12.8    | 3.2                            | 4                        | do.....          | Do.               |
| 134209.....    | 13                | 12.5    | 3.2                            | 3.8                      | do.....          | Do.               |
| 134209.....    | 14                | 12.3    | 3.2                            | 3.8                      | do.....          | Do.               |
| 134209.....    | 13                | 13      | 3.6                            | 4                        | do.....          | Do.               |
| 134209.....    | 13                | 12.9    | 3.4                            | 3.9                      | do.....          | Do.               |
| 134209.....    | 13                | 13      | 3.3                            | 3.9                      | do.....          | Do.               |
| Average.....   | 13.22+            | 12.7    | 3.35+                          | 3.95+                    |                  |                   |
| Total average. | 13.96             | 12.86   | 3.22                           | 3.85                     |                  |                   |

*Measurements of Holospira (Holospira) goldfussi anacachensis.*

| Cat. No.    | Number of whorls. | Length. | Diameter of penultimate whorl. | Diameter of tenth whorl. | Locality.                | Collector.     |
|-------------|-------------------|---------|--------------------------------|--------------------------|--------------------------|----------------|
| 187543..... | 14                | mm.     | mm.                            | mm.                      | 20 miles north of Brack- | T. W. Stanton. |
|             |                   | 13.2    | 3.4                            | 4                        | ettsville, Hillcoal's    |                |
| 187543..... | 14                | 14.2    | 3.4                            | 4.1                      | do.....                  | Do.            |
| 187543..... | 13                | 11      | 3                              | 3.7                      | do.....                  | Do.            |
| Average...  | 13.66+            | 12.8    | 3.26                           | 3.93                     |                          |                |
| 187544..... | 15                | 14.5    | 3.3                            | 4                        | Anacacha Mountains,      | T. W. Stanton. |
|             |                   |         |                                |                          | 6 to 8 miles east of     |                |
|             |                   |         |                                |                          | Spofford.                |                |
| 187544..... | 13                | 12.8    | 3.5                            | 3.9                      | do.....                  | Do.            |
| 187544..... | 15                | 13.8    | 3.2                            | 3.9                      | do.....                  | Do.            |
| 187544..... | 13                | 12.5    | 3.4                            | 3.7                      | do.....                  | Do.            |
| 187544..... | 12                | 11.9    | 3                              | 3.7                      | do.....                  | Do.            |
| 187544..... | 13                | 13.2    | 3.3                            | 4                        | do.....                  | Do.            |
| 187544..... | 14                | 13.7    | 3.3                            | 3.8                      | do.....                  | Do.            |
| 187544..... | 13                | 12.6    | 3.3                            | 3.5                      | do.....                  | Do.            |
| 187544..... | 13                | 12.2    | 3.5                            | 4                        | do.....                  | Do.            |
| 187544..... | 13                | 13      | 3.3                            | 4                        | do.....                  | Do.            |
| 187544..... | 13                | 13.3    | 3.2                            | 3.9                      | do.....                  | Do.            |
| 187544..... | 14                | 13.5    | 3.3                            | 4.1                      | do.....                  | Do.            |
| 187544..... | 13                | 11.5    | 3.2                            | 3.7                      | do.....                  | Do.            |
| 187544..... | 13                | 12.6    | 3.1                            | 4                        | do.....                  | Do.            |
| 187544..... | 13                | 12.8    | 3.2                            | 3.8                      | do.....                  | Do.            |

*Measurements of Holospira (Holospira) goldfussi anacachensis*—Continued.

| Cat. No.                  | Number of whorls. | Length.     | Diameter of penultimate whorl. | Diameter of tenth whorl. | Locality.                                                                         | Collector.                          |
|---------------------------|-------------------|-------------|--------------------------------|--------------------------|-----------------------------------------------------------------------------------|-------------------------------------|
| 187544.....               | 13                | mm.<br>12.7 | mm.<br>3.2                     | mm.<br>3.9               | Anacacha Mountains,<br>6 to 8 miles east of<br>Spofford.                          | T. W. Stanton.                      |
| 187544.....               | 13                | 12.8        | 3.4                            | 4.2                      | do.....                                                                           | Do.                                 |
| 187544.....               | 13                | 12.3        | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187544.....               | 13                | 12.3        | 3.3                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187544.....               | 14                | 14.2        | 3.3                            | 3.9                      | do.....                                                                           | Do.                                 |
| 187544.....               | 12                | 12          | 3.4                            | 4                        | do.....                                                                           | Do.                                 |
| 187544.....               | 13                | 12.3        | 3.4                            | 4                        | do.....                                                                           | Do.                                 |
| 187544.....               | 13                | 12.2        | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187544.....               | 14                | 12.9        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187544.....               | 14                | 13.2        | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| Average...                | 13.28             | 12.83       | 3.27+                          | 3.87+                    |                                                                                   |                                     |
| Largest...                | 15                | 14.5        | 3.5                            | 4.2                      |                                                                                   |                                     |
| Smallest...               | 12                | 11.5        | 3                              | 3.5                      |                                                                                   |                                     |
| 187545.....               | 14                | 14.5        | 3.6                            | 4                        | Anacacha Mountains,<br>near Frying Valley,<br>6 miles southwest of<br>Cline, Tex. | T. W. Stanton.                      |
| 187545.....               | 14                | 13.9        | 3.3                            | 4                        | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 12.3        | 3.3                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 12.3        | 3.3                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 12.1        | 3.1                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187545 <sup>a</sup> ..... | 13                | 12.1        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 11.2        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 12.3        | 3.1                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 12          | 3.1                            | 3.6                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 11.5        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 11.5        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 10.8        | 3.3                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187545.....               | 12                | 10.7        | 3.2                            | 3.4                      | do.....                                                                           | Do.                                 |
| 187545.....               | 13                | 11.1        | 3.2                            | 3.5                      | do.....                                                                           | Do.                                 |
| 187545.....               | 12                | 10.3        | 3                              | 3.4                      | do.....                                                                           | Do.                                 |
| Average...                | 13                | 11.8+       | 3.22                           | 3.7—                     |                                                                                   |                                     |
| Largest...                | 14                | 14.5        | 3.6                            | 4                        |                                                                                   |                                     |
| Smallest...               | 12                | 10.3        | 3                              | 3.4                      |                                                                                   |                                     |
| 187546.....               | 15                | 16          | 3.3                            | 4.1                      | Elm Creek, about 6<br>miles above Eagle<br>Pass, Tex.                             | T. W. Vaughan and<br>T. W. Stanton. |
| 187546.....               | 15                | 14          | 3.3                            | 4                        | do.....                                                                           | Do.                                 |
| 187546.....               | 14                | 13.3        | 3.3                            | 3.9                      | do.....                                                                           | Do.                                 |
| 187546.....               | 14                | 13.2        | 3.2                            | 3.7                      | do.....                                                                           | Do.                                 |
| 187546.....               | 13                | 12.8        | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187546.....               | 13                | 12.2        | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| 187546.....               | 13                | 12          | 3.2                            | 3.8                      | do.....                                                                           | Do.                                 |
| Average...                | 13.88+            | 13.35       | 3.24+                          | 3.87+                    |                                                                                   |                                     |
| Total average.            | 13.31             | 12.47—      | 3.25                           | 3.83                     | Anacacha Mountain<br>locus.                                                       |                                     |

<sup>a</sup> Type.

*Variation in the number of ribs in Holospira (Holospira) goldfussi.*

| Cat. No.    | Number of ribs on penultimate whorl. | Number of ribs on tenth whorl. | Locality.      |
|-------------|--------------------------------------|--------------------------------|----------------|
| 8693.....   | 40                                   | 56                             | Blanco River.  |
| 26554.....  | 32                                   | 56                             | Do.            |
| 58029.....  | 34                                   | 56                             | San Marcos.    |
| 123753..... | 34                                   | 54                             | New Braunfels. |
| 97450.....  | 36                                   | 56                             | Do.            |
| Average.    | 35.4                                 | 55.4                           |                |

*Variations in the number of ribs in Holospira (Holospira) goldfussi anacachensis.*

| Cat. No.    | Number of ribs on penultimate whorl. | Number of ribs on tenth whorl. | Locality.                                          |
|-------------|--------------------------------------|--------------------------------|----------------------------------------------------|
| 187543..... | 26                                   | 36                             | 20 miles north of Brackettsville.                  |
| 187544..... | 24                                   | 34                             | Anacacha Mountains, 6 to 8 miles east of Spofford. |
| 187544..... | 24                                   | 38                             | Do.                                                |
| 187545..... | 22                                   | 36                             | Anacacha Mountains, 6 miles southwest of Cline.    |
| 187545..... | 20                                   | 34                             | Do.                                                |
| 187546..... | 24                                   | 36                             | Elm Creek, 6 miles above Eagle Pass.               |
| 187546..... | 24                                   | 40                             | Do.                                                |
| Average.    | 23.4                                 | 36.4                           |                                                    |

*Number of Holospira (Holospira) goldfussi Menke examined.*

| Cat. No.    | Locality.                      | Number of specimens. |                         |
|-------------|--------------------------------|----------------------|-------------------------|
|             |                                | Perfect.             | Immature and fragments. |
| 8693.....   | Blanco River, Texas.....       | 1                    | 1                       |
| 26554.....  | do.....                        | 1                    | 8                       |
| 58029.....  | San Marcos, Tex.....           | 3                    |                         |
| 123753..... | New Braunfels, Tex.....        | 7                    |                         |
| 97450.....  | do.....                        | 4                    |                         |
| 134209..... | do.....                        | 5                    |                         |
| 47085.....  | Specific locality ? Texas..... | 3                    |                         |
| Total.....  |                                | 24                   | 9                       |

*Number of Holospira (Holospira) goldfussi anacachensis examined.*

| Cat. No.    | Locality.                                                     | Number of specimens. |                         |
|-------------|---------------------------------------------------------------|----------------------|-------------------------|
|             |                                                               | Perfect.             | Immature and fragments. |
| 152941..... | Edwards County, Tex.....                                      |                      | 3                       |
| 187543..... | 20 miles north of Brackettsville, Tex.....                    | 3                    |                         |
| 187544..... | Anacacha Mountains, 6 to 8 miles East of Spofford, Texas..... | 28                   | 32                      |
| 187545..... | Anacacha Mountains, 6 miles south west of Cline, Texas.....   | a 17                 | 13                      |
| 187546..... | Elm Creek, 6 miles above Eagle Pass, Texas.....               | 7                    |                         |
| Total.....  |                                                               | 55                   | 48                      |

a One=type.

The type comes from Frying Pan Valley, 6 miles southwest of Cline, Texas. It has 13 whorls and measures: Length, 12.1 mm.; diameter of penultimate whorl, 3.2 mm.; diameter of tenth whorl, 3.7 mm. The penultimate whorl has 22 ribs, the tenth whorl, 30.



*HOLOSPIRA (HOLOSPIRA) MEXICANA*, new species.

Plate IV, fig. 9.

Shell subcylindric with gradually tapering terminal cone, yellowish horn color, with irregularly distributed whitish areas, resembling frosting. Nuclear whorls two and one-half, the second one inflated, all very finely granulose. Post-nuclear whorls quite well rounded, the greatest convexity falling a little posterior to the middle between sutures. The last three or four whorls are somewhat contracted anteriorly. The whorls are marked by irregular and irregularly spaced, ill-defined riblets, which are best developed on the early whorls and the last half of the last volution. On the fifth whorl there are about 56 of these slender, obliquely backward slanting threads, while the tenth shows no less than 80. On the penultimate whorl the riblets number 48, but are almost obsolete. Periphery and base of the last whorl well rounded, crossed by the riblets which continue into the small perforate umbilicus. The last two millimeters of the last whorl are solute and built out. There is a well-marked angle extending over the solute portion, at the junction of the parietal wall and the columellar margin. The outer surface of the solute portion is marked by quite strong riblets, which form concentric rings, and these are more closely crowded immediately behind the peristome than farther back. Peristome decidedly expanded but not reflected (accidentally bifid in the posterior lateral margin in the type), white-edged, fading gradually to light brown within. Folds not apparent in the aperture. Internal pillar thin, polished, hollow throughout, of almost uniform diameter posterior to the thirteenth whorl, where it is equal to about one-sixth the diameter of the shell, tapering gently anteriorly from the thirteenth whorl, marked by many irregularly spaced, obliquely backward-curved whitish lines. A low, obsolete, somewhat submedian twist extends over the entire pillar. In the antepenultimate and the whorl preceding this, the axis bears a strong lamella, which attains its maximum development in the whorl preceding the antepenultimate, beyond which it extends only a half of a turn posteriorly; anteriorly the fold diminishes gradually till it disappears in the penultimate whorl. In the whorl preceding the antepenultimate, a strong, somewhat outward-curved spiral lamella hangs from the middle of the roof and extends about halfway down across the chamber, while a strong, low, spiral lamella is raised up from the middle of the floor, leaving only the space of about one-third of the height of the chamber open between these two lamellæ. On the inside of the outer lip of the same whorl there is a low spiral keel, which is opposite the open space between the two spiral lamellæ just described, that is, a little posterior to the junction of the floor and outer wall.

The unique type, Cat. No. 73987 U. S. N. M., was collected by E. Lehnert in southwest Mexico. It has 17 whorls and measures: Length, 17.4 mm.; diameter of penultimate whorl, 3.6 mm.; diameter of tenth whorl, 4.1 mm.; diameter of second whorl, 0.8 mm.

**HOLOSPIRA (HOLOSPIRA) PALMERI, new species.**

Plate IV, fig. 6.

Shell small, slender, subcylindric, terminal cone tapering very gently; light-brown to flesh color. Nuclear whorls two and one-half, very minutely granulose. Succeeding whorls well rounded on the terminal cone, almost flattened on the cylindrical portion of the spire, crossed by many subequal and subequally spaced, regular, obliquely backward slanting thread-like riblets. These riblets are less strongly developed and more closely spaced on the middle of the spire than on the two ends. In the type I counted about 46 on the fifth, 80 upon the tenth, and 56 upon the penultimate whorl. Sutures well marked. Last whorl prolonged, having the periphery and base well rounded, both of which are crossed by the ribs, which extend into the deep and broad umbilical rimation. Base not perforate. The last two millimeters of the last whorl are solute and built out. The outside of this part is marked by strong continuous ribs, which form a series of concentric circles about it. The parietal wall in the free part is decidedly pinched at about one-third of the way to the left of its junction with the outer wall, which renders the posterior lateral angle keeled. Junction of parietal wall and columella well rounded. Outer wall of solute portion somewhat concave in the middle. Aperture subtriangular, white at the edge, grading to light brown within, peristome expanded but not reflected. Internal pillar slender, of uniform size, and hollow throughout, marked by an inconspicuous, submedian twist which appears to extend through the spire. In the penultimate whorl this twist is replaced by a strong spiral lamella, which does not extend much either way beyond the confines of this turn. A strong spiral lamella hangs from the roof in the penultimate and antepenultimate whorl; this is situated a little lateral to the middle of the space between pillar and wall and extends about one-third across the chamber. This lamella is strongly outward curved in the antepenultimate whorl. It is marked by many white lines that alternate with hyaline ones. The lines run parallel with the long axis of the lamella. The basal lamella is low, coextensive with the parietal one and opposed to it. The fourth lamella is represented by a low cord on the inside of the outer wall opposite the space between the parietal and basal lamella in the antepenultimate whorl. None of the lamellæ extend to the last whorl.

The collection contains 48 adults and 29 immature specimens and fragments of this species, Cat. No. 100388, U.S.N.M., from Alvarez Mountains, San Luis Potosi, Mexico, where they were collected by

Dr. E. Palmer, at an altitude of 7,200 feet. The following table gives measurements and average of twenty specimens:

*Measurements of Holospira (Holospira) palmeri.*

| Cat. No.              | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-----------------------|-------------------|---------|--------------------------|--------------------------------|
|                       |                   | mm.     | mm.                      | mm.                            |
| 100388 <i>a</i> ..... | 17                | 13.7    | 2.7                      | 2.3                            |
| 100388 .....          | 16                | 13.5    | 2.7                      | 2.3                            |
| 100388 .....          | 16                | 13      | 2.7                      | 2.2                            |
| 100388 .....          | 16                | 12.5    | 2.7                      | 2.3                            |
| 100388 .....          | 16                | 12.8    | 2.8                      | 2.4                            |
| 100388 .....          | 16                | 12.4    | 2.7                      | 2.4                            |
| 100388 .....          | 16                | 12      | 2.6                      | 2.3                            |
| 100388 .....          | 15                | 11.6    | 2.7                      | 2.4                            |
| 100388 .....          | 15                | 10.6    | 2.7                      | 2.2                            |
| 100388 .....          | 15                | 12      | 2.8                      | 2.2                            |
| 100388 .....          | 15                | 11      | 2.7                      | 2.2                            |
| 100388 .....          | 15                | 12.1    | 2.9                      | 2.4                            |
| 100388 .....          | 15                | 10.7    | 2.7                      | 2.3                            |
| 100388 .....          | 16                | 12.3    | 2.8                      | 2.3                            |
| 100388 .....          | 15                | 11.2    | 2.7                      | 2.1                            |
| 100388 .....          | 15                | 11.3    | 2.8                      | 2.2                            |
| 100388 .....          | 15                | 10.8    | 2.7                      | 2.2                            |
| 100388 .....          | 15                | 11.2    | 2.8                      | 2.3                            |
| 100388 .....          | 15                | 11.8    | 2.8                      | 2.4                            |
| 100388 .....          | 15                | 12.2    | 2.7                      | 2.4                            |
| Total .....           | 15.5—             | 11.93+  | 2.73+                    | 2.29                           |
| Largest .....         | 17                | 13.7    | 2.9                      | 2.4                            |
| Smallest .....        | 15                | 10.6    | 2.6                      | 2.1                            |

*a*Type.

**HOLOSPIRA (HOLOSPIRA) INFANTA, new species.**

Plate III, fig. 4.

Shell very small, cylindric, with a short terminal cone. General color bluish white, mottled here and there at widely spaced intervals by dots or streaks of horn color, terminal cone yellow-horn color. Nuclear whorls a little more than two, well rounded, shining, very minutely granulose. Later whorls moderately rounded on the early part of the terminal cone, decidedly flattened on the cylindrical part of the spire. The terminal cone is quite strongly, obliquely, ribbed, while on the cylindrical portion of the spire the ribs become much reduced and are almost obsolete. On the last whorl they are again better developed and pass quite strongly over the slightly angulated periphery and well rounded base into the small umbilical perforation. Base yellowish brown. The last whorl is very shortly free; the parietal wall is decidedly pinched about one-third to the left of its junction with the outer wall. Outer wall slightly concaved in the middle behind the peristome. Aperture well rounded anteriorly, angulated at the junction of the outer and peripheral wall, the latter sinuous. Peristome somewhat expanded and slightly reflected, white. Internal column slender, hollow, with a slightly submedian, obsolete twist extending throughout the length of the spire. In the penultimate whorl the twist on the pillar is replaced by a strong, thick lamella

which is restricted to this volution, appearing only as a strong twist in the last and in the antepenultimate turns. The parietal, basal, and peripheral lamellæ are also confined to the penultimate whorl. The parietal one is large and very strongly outward curved, the free edge bent toward the peripheral lamella, which forms a strong keel and is located about one-third the height of the chamber above the floor. The basal lamella is thick and strong and apposes the outer edge of the columellar fold and not the parietal one as is usually the case. Two narrow slits are thus formed, one between the parietal and peripheral fold, the other between the columellar and basal folds.

The unique type, Cat. No. 187650; U.S.N.M., was collected by E. W. Nelson in the Sierra Guadalupe, Coahuila, Mexico. It has  $13\frac{1}{2}$  whorls and measures: Length 9.7 mm.; diameter of tenth whorl 2.9 mm.; diameter of penultimate whorl 2.7 mm.

The diminutive size and the very regular cylindric outline distinguish this species from all the other known *Holospiras*.

**HOLOSPIRA (HOLOSPIRA) PAINTERI, new species.**

Plate III, fig. 5.

Shell small, pupoid, flesh colored to light brown. Nuclear whorls two, well rounded, shining, very minutely granulose. Succeeding whorls rather inflated, those of the conical portion decidedly rounded, the rest rounded on the posterior third between the sutures, the lower two-thirds becoming flattened and somewhat contracted anteriorly. Penultimate whorl somewhat lower than the rest and well rounded. The entire surface is marked by well developed, regular, and regularly spaced obliquely backward-slanting riblets. These riblets are a little more crowded on the middle of the spire than on the cone; in general, they will average about one-half the diameter of the spaces that separate them; this, however, does not hold on the last two turns; here they are decidedly more distantly spaced. The type has about 67 ribs upon the fifth, 86 upon the eighth, and 60 upon the penultimate whorls. Periphery of the last whorl very slightly angulated. Base yellow horn-color, imperforate. Both periphery and base are crossed by the riblets which continue into the umbilical rimation. Last whorl free and built out for about one millimeter. The free portion is crossed by sublamellar riblets, which form a series of wavy, concentric rings, that become closely crowded behind the peristome. The solute portion of the outer wall is concaved in the middle and the parietal wall is decidedly pinched about one-fourth of the way to the left of its junction with the outer wall. This renders the posterior lateral angle keeled, and gives to the aperture a channeled appearance at this place. Aperture well rounded anteriorly, having the parietal and lateral walls somewhat sinuous. The parietal and columellar folds are both visible deeply within the aperture. Peristome decidedly ex-



panded and somewhat revolute, white, fading to light brown within. Internal pillar slender, hollow throughout, having a low submedian twist, which extends over the entire spire. In the last and penultimate whorl this twist is replaced by a moderately strong, rather thick spiral lamella, which is of about equal strength in the two whorls mentioned; it can be easily seen within the aperture, but does not extend into the penultimate whorl. The parietal lamella extends through the last two turns and is also visible deeply within the aperture; it is slender, quite wide and decidedly outward curved, the free edge pointing toward the rounded, cord-like peripheral fold, which is located a little below the middle on the inside of the outer wall; it transverses only part of the penultimate whorl. A narrow slit only separates these two lamellæ. The basal lamella is very much reduced and surpasses the peripheral lamella in height only for about a quarter of a turn. The peripheral fold is visible on the outside of the whorl as a white thread. The collection contains 44 specimens, Cat. No. 187675, U.S.N.M., all collected by J. N. Rose and J. H. Painter, at Tehuacan, Puebla, Mexico. The following table gives measurements of twenty specimens:

*Measurements of Holospira (Holospira) painteri.*

| Cat. No.              | Number of whorls. | Length.    | Diameter of eighth whorl. | Diameter of penultimate whorl. |
|-----------------------|-------------------|------------|---------------------------|--------------------------------|
|                       |                   | <i>mm.</i> | <i>mm.</i>                | <i>mm.</i>                     |
| 187675 <i>a</i> ..... | 10.5              | 8.4        | 2.7                       | 2.3                            |
| 187675 .....          | 11                | 8.7        | 2.7                       | 2.3                            |
| 187675 .....          | 10                | 8.1        | 2.7                       | 2.2                            |
| 187675 .....          | 10.5              | 8.3        | 2.7                       | 2.4                            |
| 187675 .....          | 10.5              | 8          | 2.7                       | 2.2                            |
| 187675 .....          | 10.5              | 8.2        | 2.7                       | 2.2                            |
| 187675 .....          | 11                | 9.1        | 2.9                       | 2.5                            |
| 187675 .....          | 10.5              | 8.1        | 2.7                       | 2.2                            |
| 187675 .....          | 11                | 9.1        | 2.7                       | 2.2                            |
| 187675 .....          | 10                | 8          | 2.6                       | 2.1                            |
| 187675 .....          | 11                | 8.5        | 2.6                       | 2.2                            |
| 187675 .....          | 11                | 8          | 2.6                       | 2.2                            |
| 187675 .....          | 11                | 8.1        | 2.7                       | 2.3                            |
| 187675 .....          | 11                | 8.6        | 2.7                       | 2.3                            |
| 187675 .....          | 11                | 8.9        | 2.8                       | 2.2                            |
| 187675 .....          | 10.5              | 7.8        | 2.7                       | 2.2                            |
| 187675 .....          | 11                | 9.1        | 2.7                       | 2.3                            |
| 187675 .....          | 10                | 8.8        | 2.7                       | 2.2                            |
| 187675 .....          | 10                | 8.2        | 2.6                       | 2.2                            |
| 187675 .....          | 11                | 8.3        | 2.7                       | 2.2                            |
| Average ...           | 10.65             | 8.41       | 2.7—                      | 2.23                           |
| Largest ...           | 11                | 9.1        | 2.9                       | 2.5                            |
| Smallest ...          | 10                | 7.8        | 2.6                       | 2.1                            |

*a* Type.

## HOLOSPIRA (HOLOSPIRA) NELSONI Pilsbry.

The U. S. National Museum has 43 specimens of this species, Cat. No. 187785, collected by E. W. Nelson and E. A. Goldman at Sierra Guadalupe, Coahuila, Mexico, at an altitude of 9,500 feet. The following table gives measurements of twenty individuals:

*Measurements of Holospira (Holospira) nelsoni.*

| Cat. No.    | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of thirteenth whorl. | Diameter of penultimate whorl. |
|-------------|-------------------|---------|--------------------------|-------------------------------|--------------------------------|
|             |                   | mm.     | mm.                      | mm.                           | mm.                            |
| 187785..... | 16                | 16.8    | 4.3                      | 4.9                           | 4.5                            |
| 187785..... | 16                | 16.8    | 4.6                      | 4.8                           | 4.3                            |
| 187785..... | 16                | 16      | 4.3                      | 4.9                           | 4.5                            |
| 187785..... | 16                | 16.9    | 4.4                      | 4.9                           | 4.5                            |
| 187785..... | 17                | 18.5    | 4.2                      | 4.9                           | 4.5                            |
| 187785..... | 15                | 15.8    | 4.7                      | 5.2                           | 4.7                            |
| 187785..... | 16                | 18.5    | 4.5                      | 5                             | 4.3                            |
| 187785..... | 16                | 17.5    | 4.2                      | 4.8                           | 4.6                            |
| 187785..... | 16                | 16.9    | 4.3                      | 4.8                           | 4.3                            |
| 187785..... | 16                | 16.6    | 4.3                      | 4.9                           | 4.5                            |
| 187785..... | 16                | 16.3    | 4.3                      | 4.9                           | 4.4                            |
| 187785..... | 15                | 16      | 4.4                      | 5                             | 4.6                            |
| 187785..... | 16                | 16      | 4.5                      | 5.1                           | 4.7                            |
| 187785..... | 16                | 17.5    | 4.4                      | 5                             | 4.7                            |
| 187785..... | 16                | 17.5    | 4.3                      | 5.1                           | 4.6                            |
| 187785..... | 15                | 16.4    | 4.6                      | 4.9                           | 4.5                            |
| 187785..... | 16                | 16.3    | 4.5                      | 5                             | 4.5                            |
| 187785..... | 16                | 15.4    | 4.6                      | 5.1                           | 4.5                            |
| 187785..... | 15                | 16.2    | 4.5                      | 5.1                           | 4.3                            |
| 187785..... | 16                | 16.2    | 4                        | 4.7                           | 4.2                            |
| Average...  | 15.85             | 16.7    | 4.43                     | 4.95                          | 4.48                           |
| Largest.... | 17                | 18.5    | 4.7                      | 5.2                           | 4.7                            |
| Smallest... | 15                | 15.4    | 4                        | 4.7                           | 4.2                            |

## HOLOSPIRA (HOLOSPIRA) OAXACANA, new species.

Plate IV, fig. 5.

Shell quite large, strong, cylindric conic, white. Nuclear whorls two, moderately large, well rounded, very minutely granulose. Terminal cone evenly tapering, the last six whorls of the spire quite cylindrical. The whorls of the cone are a little more rounded than those of the cylindrical portion; they are all crossed by obliquely backward slanting thread-like riblets, which are a little more strongly developed and more distantly spaced on the early and last whorls than the middle ones. There appear to be about 56 of these riblets on the fourth, 160 upon the eighth, and 100 upon the penultimate whorl in the type. Sutures well marked. Periphery of the last whorl slightly angulated. Base short and well rounded. The periphery and base are crossed by the continuations of the riblets, which extend undiminished into the rather deep umbilical rimation. Last whorl free for about one millimeter. Aperture semioval, the parietal wall representing the short diameter of the oval white. Peristome broadly expanded but not reflected, white. Internal column very slender, hollow, with an obsolete submedian twist. In the penultimate whorl this twist is replaced

by a moderately developed, spiral lamella, which extends feebly into the first half of the last whorl anteriorly, and hardly reaches to the antepenultimate posteriorly. The parietal lamella is one turn long and is chiefly located in the penultimate whorl, the very much attenuated anterior portion only extending partly into the last volution. In its greatest development the lamella extends about halfway across the chamber; the lamella is thin and decidedly outward curved in the direction of the peripheral fold. Peripheral fold slender, a mere thread extending through about half a volution, situated about one-third of the height of the chamber above the floor. Basal fold low, coextensive with the parietal member.

There are three specimens in the collection of the U. S. National Museum, Cat. No. 175085, collected by C. R. Orcutt at Tomellin, Oaxaca, Mexico.

Measurements of *Holospira* (*Holospira*) *oaxacana*.

| Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|--------------------------|--------------------------------|
|                   | mm.     | mm.                      | mm.                            |
| a 12              | 17.5    | 5.3                      | 4.8                            |
| 12                | 15.5    | 5.2                      | 4.7                            |
| 12                | 15.5    | 5.1                      | 4.6                            |

a Type.

TRISTEMMA, new subgenus.

*Holospiras* having three internal lamellæ, i. e., an axial, a parietal, and a basal.

Type.—*Holospira ferrissi* Pilsbry.

Two species belong to this subgenus, *Holospira* (*Tristemma*) *ferrissi* Pilsbry and *Holospira* (*Tristemma*) *pfeifferi* Menke.

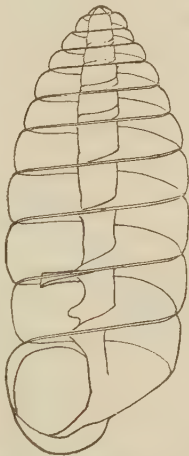


FIG. 9.—INTERIOR VIEW OF *HOLOSPIRA FERRISSI*.

*HOLOSPIRA* (*TRISTEMMA*) *FERRISSI* Pilsbry.

The U. S. National Museum contains three specimens, Cat. No. 189875, of this species, collected by J. H. Ferriss at Manila Mine, Huachuca Mountains, Arizona. These are part of the original lot and were donated by H. A. Pilsbry.

Measurements of *Holospira ferrissi*.

| Cat. No.       | Number of whorls. | Length. | Diameter of eighth whorl. | Diameter of penultimate whorl. |
|----------------|-------------------|---------|---------------------------|--------------------------------|
|                |                   | mm.     | mm.                       | mm.                            |
| 189875 a ..... | 11                | 8.1     | 3.4                       | 3.2                            |
| 189875 .....   | 11                | 8       | 3.5                       | 3.1                            |
| 189875 .....   | 11                | 8.3     | 3.4                       | 3.2                            |

a Specimen figured.

## HOLOSPIRA (EUDISTEMMA) ARIZONENSIS Stearns.

There are fourteen fragments and one perfect specimen of this species in the collection of the U. S. National Museum, Cat. No. 104392, collected by Vernon Bailey in a cave at Dos Cabezas, Arizona. The perfect specimen, which is the type, has 12 whorls and measures: Length, 12.8 mm.; diameter of tenth whorl, 4.2 mm.; diameter of penultimate whorl, 3.8 mm. This is the type of *Eudistemma* Dall.

## HOLOSPIRA (DISTOMOSPIRA) BILAMELLATA Dall.

The U. S. National Museum collection contains 35 fragments and 8 perfect specimens of this species, Cat. No. 129990, collected by Maj. E. A. Mearns, on the top of Hachita Grande Mountains, New Mexico. This species is the type of "*Distomospira*," Dall. The eight perfect specimens measure:

*Measurements of Holospira (Distomospira) bilamellata.*

| Cat. No.                  | Number of whorls. | Length. | Diameter of twelfth whorl. | Diameter of penultimate whorl. |
|---------------------------|-------------------|---------|----------------------------|--------------------------------|
|                           |                   | mm.     | mm.                        | mm.                            |
| 129990 <sup>a</sup> ..... | 17                | 20.5    | 4.9                        | 4.2                            |
| 129990.....               | 17                | 19.5    | 5.5                        | 4.5                            |
| 129990.....               | 17                | 20.2    | 5                          | 4.3                            |
| 129990.....               | 16                | 20      | 5.5                        | 4.4                            |
| 129990.....               | 16                | 20.1    | 5                          | 4.4                            |
| 129990.....               | 16                | 19.1    | 5.3                        | 4.4                            |
| 129990.....               | 15                | 16      | 4.8                        | 4.3                            |
| 129990.....               | 14                | 16      | 5                          | 4.4                            |
| Average .....             | 16                | 18.3    | 5.22                       | 4.36                           |
| Largest .....             | 17                | 20.5    | 5.5                        | 4.5                            |
| Smallest .....            | 14                | 16      | 4.8                        | 4.2                            |

<sup>a</sup> Type.

## HOLOSPIRA (DISTOMOSPIRA) MEARNSI Dall.

There are 6 perfect and 3 fragments of this species in the U. S. National Museum collection, Cat. No. 129991. They were collected by Maj. E. A. Mearns on the top of the Hachita Grande Mountains, Grant County, New Mexico.

*Measurements of Holospira (Distomospira) mearnsi.*

| Cat. No.       | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|----------------|-------------------|---------|--------------------------|--------------------------------|
|                |                   | mm.     | mm.                      | mm.                            |
| 129991.....    | α 14              | 14.6    | 4.3                      | 4                              |
| 129991.....    | 14                | 15.8    | 4.5                      | 4                              |
| 129991.....    | 14                | 15.4    | 4.5                      | 4                              |
| 129991.....    | 14                | 14      | 4.4                      | 3.8                            |
| 129991.....    | 14                | 15      | 4.2                      | 3.8                            |
| 129991.....    | 14                | 15      | 4.5                      | 4                              |
| Average .....  | 14                | 15      | 4.4                      | 3.92                           |
| Largest .....  | 14                | 15.8    | 4.5                      | 4                              |
| Smallest ..... | 14                | 14.6    | 4.2                      | 3.8                            |

<sup>a</sup> Type.



This species was made the type of the section *Haplostemma* by Doctor Dall, which is characterized as having a short, stout, axial lamella only. There was one specimen in the collection which had the outer wall on one side removed to expose the pillar; the removal of the wall seems to have carried away a small portion of the septum, separating the last whorl from the penultimate, and this unfortunately happened to be just the place upon which the short (poorly developed) basal fold is situated.

*Haplostemma*, therefore, must be considered a synonym of *Distomospira*. The basal fold extends over about one-fifth of a turn on the floor of the penultimate whorl.

#### HOLOSPIRA (BOSTRICHOCENTRUM) TRYONI Pfeiffer.

There is one specimen of this species, Cat. No. 107325 U.S.N.M., in the collection which comes from Salle, and was collected at the type locality, Matamoros de Izucar, Puebla, Mexico. The specimen has 15 whorls and measures: Length, 12.5 mm.; diameter of tenth whorl, 4.4 mm.; diameter of penultimate whorl, 3.8 mm.

#### HOLOSPIRA (BOSTRICHOCENTRUM) PILSBRYI Dall.

There are two lots of this species in the collection, one specimen, Cat. No. 21762 U.S.N.M., labeled Mexico, without specific data, the other, Cat. No. 56932, U.S.N.M., containing 120 specimens, was collected about the sulphur springs around the city of Puebla, Puebla, Mexico, by the Mexican Geographic Commission. The following table gives measurements of 20 specimens from the last lot containing the type:

*Measurements of Holospira (Bostrichocentrum) pilsbryi.*

| Cat. No.             | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|----------------------|-------------------|---------|--------------------------|--------------------------------|
|                      |                   | mm.     | mm.                      | mm.                            |
| 56932 <i>a</i> ..... | 14.5              | 13.6    | 3.8                      | 3.4                            |
| 56932 .....          | 12.5              | 10.5    | 3.5                      | 3.3                            |
| 56932 .....          | 13                | 11.3    | 3.7                      | 3.5                            |
| 56932 .....          | 12.5              | 11.1    | 3.8                      | 3.6                            |
| 56932 .....          | 12                | 10.3    | 3.8                      | 3.4                            |
| 56932 .....          | 13                | 11.3    | 3.7                      | 3.5                            |
| 56932 .....          | 13                | 12.2    | 3.9                      | 3.7                            |
| 56932 .....          | 14                | 13      | 3.7                      | 3.4                            |
| 56932 .....          | 14                | 12.9    | 3.7                      | 3.4                            |
| 56932 .....          | 12                | 11      | 3.8                      | 3.4                            |
| 56932 .....          | 14                | 13.3    | 4.1                      | 3.7                            |
| 56932 .....          | 13.5              | 12.7    | 3.8                      | 3.2                            |
| 56932 .....          | 13                | 12.8    | 4                        | 3.7                            |
| 56932 .....          | 12                | 10.2    | 3.7                      | 3.3                            |
| 56932 .....          | 13                | 10.4    | 3.7                      | 3.2                            |
| 56932 .....          | 13                | 11.1    | 4                        | 3.6                            |
| 56932 .....          | 13                | 12.4    | 3.9                      | 3.7                            |
| 56932 .....          | 13.5              | 12.2    | 3.8                      | 3.3                            |
| 56932 .....          | 13                | 11.6    | 3.7                      | 3.3                            |
| 56932 .....          | 12                | 10.6    | 3.6                      | 3.2                            |
| Average .....        | 13.05             | 11.75   | 3.78                     | 3.44                           |
| Largest .....        | 14.5              | 13.6    | 4.1                      | 3.7                            |
| Smallest .....       | 12                | 10.2    | 3.5                      | 3.2                            |

*a* Type.

## HOLOSPIRA (BOSTRICHOCENTRUM) VERACRUZIANA Dall.

There are three specimens of this species in the collection of the U. S. National Museum, Cat. No. 56933, collected by the Mexican Geographic Commission, at Mizantla, Vera Cruz, Mexico. They give the following measurements:

*Measurements of Holospira (Bostrichocentrum) veracruziana.*

| Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|--------------------------|--------------------------------|
|                   | mm.     | mm.                      | mm.                            |
| a 17              | 17.5    | 5.6                      | 5.1                            |
| b 15              | 15.4    | 5.4                      | 5                              |
| b 15              | 15      | 5.4                      | 5                              |

a Type.

b Not quite mature.

## HOLOSPIRA (BOSTRICHOCENTRUM) GOLDMANI, new species.

Plate IV, fig. 1.

Shell cylindric-conic, thick, white. Terminal cone short, broadly conic. Nuclear whorls one and three-fourths, well rounded, very finely granulose. The four whorls of the terminal cone are well rounded and crossed by many quite regular and regularly spaced oblique riblets, whorls of the cylindric portion of the spire are almost flattened and marked by ill-defined, irregular indications of oblique riblets. On the last half of the last whorl the riblets again assume a stronger character, but are not as regular as on the terminal cone. Periphery of the last whorl obsoletely angulated. Base well rounded, crossed by the ill-defined riblets which extend into the minute umbilical perforation. The last whorl is very shortly free and quite strongly angulated in the posterior lateral angle. Aperture broadly pyriform; peristome expanded, but not revolute, somewhat thickened, white. Internal pillar moderately large, of uniform diameter throughout the cylindrical portion, somewhat narrower in the last turn, marked by a low submedian fold, which becomes sublamellar in the antepenultimate and penultimate turn and disappears altogether before reaching the aperture.

There are 22 specimens in the collection of the U. S. National Museum, Cat. No. 187793. They were collected by E. W. Nelson and E. A. Goldman, at Tamazulapan, Oaxaca, Mexico.

The following table gives a list of measurements:

*Measurements of Holospira (Bostrichocentrum) goldmani.*

| Cat. No.                  | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|---------------------------|-------------------|---------|--------------------------|--------------------------------|
|                           |                   | mm.     | mm.                      | mm.                            |
| 187793.....               | 14                | 15.8    | 5.9                      | 5.4                            |
| 187793.....               | 13                | 15      | 5.5                      | 5                              |
| 187793.....               | 13                | 16.4    | 5.4                      | 4.8                            |
| 187793.....               | 13                | 16      | 5.8                      | 5.4                            |
| 187793.....               | 13                | 16      | 5.8                      | 5.4                            |
| 187793.....               | 13                | 15      | 5.5                      | 5.1                            |
| 187793.....               | 12                | 14.5    | 5.6                      | 5                              |
| 187793.....               | 13                | 15.4    | 5.8                      | 5.2                            |
| 187793.....               | 12                | 14.3    | 5.8                      | 5                              |
| 187793.....               | 13                | 15.1    | 5.7                      | 5.4                            |
| 187793.....               | 12                | 13.9    | 5.9                      | 5.2                            |
| 187793.....               | 12                | 14.5    | 6.3                      | 5.3                            |
| 187793 <sup>a</sup> ..... | 13                | 14.9    | 5.6                      | 5.1                            |
| 187793.....               | 12                | 13.4    | 5.6                      | 5.1                            |
| 187793.....               | 12                | 14.6    | 5.5                      | 5                              |
| 187793.....               | 13                | 16      | 5.7                      | 5.2                            |
| 187793.....               | 13                | 14.6    | 5.3                      | 5                              |
| 187793.....               | 12                | 13.4    | 5.4                      | 4.7                            |
| 187793.....               | 12                | 13.8    | 5.6                      | 5.1                            |
| 187793.....               | 13                | 15.1    | 5.7                      | 5                              |
| 187793.....               | 12                | 14.3    | 5.3                      | 4.7                            |
| 187793.....               | 12                | 13      | 5.7                      | 5.2                            |
| Average....               | 12.59             | 14.7    | 5.64                     | 5.1                            |
| Largest....               | 14                | 16.4    | 6.3                      | 5.4                            |
| Smallest....              | 12.               | 13      | 5.3                      | 4.7                            |

<sup>a</sup> Type.

In some specimens the part succeeding the terminal cone is the broadest part of the shell, the rest of the spire tapering gradually toward the last whorl.

**HOLOSPIRA (BOSTRICHOCENTRUM) CROSSEI Dall.**

There are 12 perfect and 10 immature and imperfect specimens in the collection of the U. S. National Museum, Cat. No. 129989, all collected by Maj. E. A. Mearns, at the highest peak of the Hachita Grande Mountains, New Mexico. The 12 perfect individuals give the following measurements:

*Measurements of Holospira (Bostrichocentrum) crossei.*

| Cat. No.                  | Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|---------------------------|-------------------|---------|--------------------------|--------------------------------|
|                           |                   | mm.     | mm.                      | mm.                            |
| 129989 <sup>a</sup> ..... | 13                | 11.6    | 3.8                      | 3.7                            |
| 129989.....               | 13                | 12      | 3.8                      | 3.7                            |
| 129989.....               | 12                | 11.9    | 4.2                      | 3.9                            |
| 129989.....               | 13                | 12.3    | 4                        | 3.8                            |
| 129989.....               | 13                | 11.6    | 3.9                      | 3.5                            |
| 129989.....               | 13                | 11.5    | 4.1                      | 3.7                            |
| 129989.....               | 13                | 11.2    | 3.7                      | 3.7                            |
| 129989.....               | 12                | 11.6    | 3.9                      | 3.5                            |
| 129989.....               | 13                | 12.2    | 3.9                      | 3.5                            |
| 129989.....               | 12                | 11      | 3.8                      | 3.4                            |
| 129989.....               | 12                | 10.4    | 3.5                      | 3.5                            |
| 129989.....               | 13                | 12.3    | 3.9                      | 3.7                            |
| Average....               | 12.26             | 11.63   | 3.87                     | 3.65                           |
| Largest....               | 13                | 12.3    | 4.2                      | 3.9                            |
| Smallest....              | 12                | 11      | 3.5                      | 3.4                            |

<sup>a</sup> Type.

As Doctor Pilsbry has pointed out,<sup>a</sup> there is a weak, short fold, more like a tooth upon the axis, in the penultimate whorl, near the basal wall. There is also a weak submedian twist, which extends through the spire. The ribbing of the exterior varies from very decided, as shown in the figure of the type,<sup>b</sup> to subobsolete on the middle of the cylindrical portion, as shown by Doctor Pilsbry's figure.<sup>c</sup>

**HOLOSPIRA (BOSTRICHOCENTRUM) HIDALGOENSIS, new species.**

Plate IV, fig. 12.

Shell slender, elongate, cylindric-conic, white. Terminal cone gradually tapering. Nuclear whorls 3, moderately rounded, increasing regularly in size, very minutely granulose. The first nuclear whorl is broad and lends the apex a somewhat truncated appearance. Succeeding whorls flattened, the early ones of the terminal cone slightly overhanging, all marked by strong, curved, somewhat distantly spaced sublamellar ribs, of which about 28 occur upon the first sculptured whorl (i. e., the fourth whorl), 40 upon the tenth, and 26 upon the penultimate whorl. The ribs are placed closest posteriorly and become gradually more distantly spaced toward the penultimate whorl. The wide spaces between the ribs are crossed by several irregular secondary riblets, which lend them a longitudinally crinkled appearance. Periphery of the last whorl somewhat angulated. Base well rounded; the strong continuation of the ribs extend into the umbilical rimation. The last portion of the last whorl free for about 3 mm. Parietal wall somewhat pinched a little to the left of its junction with the outer wall, which lends the posterior lateral angle a slightly carinated appearance. The free parietal wall is marked by the continuation of the ribs, which are less strongly developed and more closely crowded immediately behind the aperture. Aperture subquadrate, parietal border somewhat sinuous, owing to the pinched portion alluded to above; peristome decidedly expanded, but not revolute. Internal pillar slender, bearing an obsolete submedian spiral twist that is strengthened to form a low lamella, which extends through the antepenultimate whorl. There are two specimens in the collection of the U. S. National Museum, Cat. No. 187982, donated by A. L. Herrera. They were collected at Zimapan, Hidalgo, Mexico.

<sup>a</sup> Proc. Acad. Nat. Sci. Philadelphia, 1905, p. 217.

<sup>b</sup> Proc. U. S. Nat. Mus., XIX, 1896, pl. xxxi, fig. 2.

<sup>c</sup> Proc. Acad. Nat. Sci. Philadelphia, 1905, pl. xxvi, fig. 8.



*Measurements of Holospira (Bostrichocentrum) hidalgoensis.*

| Number of whorls. | Length | Diameter of tenth whorls. | Diameter of penultimate whorl. |
|-------------------|--------|---------------------------|--------------------------------|
|                   | mm.    | mm.                       | mm.                            |
| 17                | 20.5   | 4.2                       | 3.8                            |
| 16                | 20.3   | 4.3                       | 4                              |

a Type.

**HOLOSPIRA (BOSTRICHOCENTRUM) TAMAULIPENSIS, new series.**

Plate IV, fig. 2.

Shell elongate-conic, horn-colored, with strong white riblets. Nuclear whorls two, light yellow-horn-color, very minutely granulose. Terminal cone long and gently tapering, having the whorls moderately well rounded. Cylindrical portion of the spire consisting of the last three or four volutions. All the whorls are strongly and quite regularly ribbed. The ribs are slender, somewhat compressed laterally, forming low lamellæ, about one-fourth as wide as the spaces which separate them. In the type there are 40 upon the second ribbed (i. e., the fourth) whorl, 56 upon the ninth, and 54 upon the penultimate volution. Sutures well impressed. Last whorl somewhat elongated and narrowed basally. Periphery slightly angulated. Base well rounded, marked by the rather crowded continuations of the ribs, which extend strongly into the umbilical rimation. Last whorl shortly free behind the aperture; the free portion is marked by strongly lamellar riblets, which become decidedly crowded and weaker behind the peristome. The free portion of the parietal wall is decidedly pinched a little to the left of its junction with the outer wall, which lends it a somewhat sinuous outline. It is marked by the continuation of the riblets of the outer wall. Aperture oblique, semioval, the short diameter of the oval being represented by the parietal wall. Peristome quite strongly expanded but not reflected, white. Internal pillar slender, hollow throughout, marked by an obsolete submedian twist, which gives place to a weak, short fold in the penultimate whorl. This fold extends only over about half a turn and almost rests upon the floor. There are 32 specimens of this species in the collection of the U. S. National Museum, Cat. No. 187979, collected by E. W. Nelson and E. A. Goldman at Camargo, Tamaulipas, Mexico.

The following table gives measurements of the type and 14 specimens:

*Measurements of Holospira (Bostrichocentrum) tamaulipensis.*

| Cat. No.                  | Number of whorls. | Length.    | Diameter of ninth whorl. | Diameter of penultimate whorl. |
|---------------------------|-------------------|------------|--------------------------|--------------------------------|
|                           |                   | <i>mm.</i> | <i>mm.</i>               | <i>mm.</i>                     |
| 187979.....               | 12                | 12         | 4.1                      | 4.2                            |
| 187979.....               | 13.5              | 13.4       | 4.1                      | 3.8                            |
| 187979 <sup>a</sup> ..... | 12                | 12.5       | 4.1                      | 3.9                            |
| 187979.....               | 12                | 12.1       | 4.3                      | 4.2                            |
| 187979.....               | 11                | 11.5       | 4.2                      | 4.1                            |
| 187979.....               | 12.5              | 12.5       | 4.2                      | 4.1                            |
| 187979.....               | 12                | 12.3       | 4.2                      | 4.1                            |
| 187979.....               | 12                | 12.1       | 4                        | 3.7                            |
| 187979.....               | 11.5              | 11.3       | 4.3                      | 3.9                            |
| 187979.....               | 12                | 11.8       | 3.9                      | 3.8                            |
| 187979.....               | 11.5              | 11.3       | 4.1                      | 3.9                            |
| 187979.....               | 10.5              | 9.9        | 3.7                      | 3.7                            |
| 187979.....               | 12                | 12.1       | 4.4                      | 4.3                            |
| 187979.....               | 11.5              | 11.2       | 4.2                      | 4.1                            |
| 187979.....               | 13                | 12.8       | 4.3                      | 4                              |
| Average....               | 11.93             | 11.92      | 4.14                     | 3.98 +                         |
| Largest....               | 13.5              | 13.4       | 4.4                      | 4.3                            |
| Smallest....              | 11                | 9.9        | 3.7                      | 3.7                            |

<sup>a</sup> Type.

**HOLOSPIRA (BOSTRICHOCENTRUM) CIONELLA** Pilsbry.

The collection of the U. S. National Museum contains one specimen of this species, Cat. No. 173848, presented by Dr. H. A. Pilsbry and collected by J. H. Ferris, at Fort Bowie, Arizona, the type locality. It has 13 whorls and measures: Length, 12.5 mm.; diameter of tenth whorl, 3.7 mm.; diameter of penultimate whorl, 3.6 mm.

**HOLOSPIRA (BOSTRICHOCENTRUM) COCKERELLI** Dall.

The unique type of this species, Cat. No. 173845, U.S.N.M., was found by O. B. Metcalfe in the débris of the Rio Grande, at Mesilla, Sierra County, New Mexico, and donated to the Museum by Prof. T. D. A. Cockerell. It has  $13\frac{2}{3}$  whorls and measures: Length, 12.8 mm.; diameter of tenth whorl, 3.8 mm.; diameter of penultimate whorl, 3.6 mm.

**HOLOSPIRA (BOSTRICHOCENTRUM) REGIS** Pilsbry and Cockerell.

There are two specimens (topotypes) in the collection of the U. S. National Museum, Cat. No. 185388, collected by O. B. Metcalfe, near Kingston, Sierra County, New Mexico, and donated by Prof. T. D. A. Cockerell. One of these is not quite perfect; the perfect individual has 13 whorls and measures: Length, 11.1 mm.; diameter of tenth whorl, 3.4 mm.; diameter of penultimate whorl, 3.2 mm.

**HOLOSPIRA (BOSTRICHOCENTRUM) CHIRICAHUANA** Pilsbry.

There are two lots of this species in the U. S. National Museum collection; one, Cat. No. 173847, U. S. N. M., contains 6 specimens col-

lected by J. H. Ferris, at Cave Creek, Chiricahua Mountains, south-east Arizona, the type locality, which were donated by Dr. H. A. Pilsbry.

*Measurements of Holospira (Bostrichocentrum) chiricahuana.*

| Cat. No.    | Number of whorls. | Length. | Diameter of eighth whorl. | Diameter of penultimate whorl. |
|-------------|-------------------|---------|---------------------------|--------------------------------|
|             |                   | mm.     | mm.                       | mm.                            |
| 173847..... | 11                | 9       | 3                         | 2.9                            |
| 173847..... | 12                | 10      | 3.2                       | 3                              |
| 173847..... | 11                | 8.4     | 3.1                       | 2.9                            |
| 173847..... | 12                | 10.2    | 3.2                       | 3                              |
| 173847..... | 12                | 9.4     | 3                         | 2.9                            |
| 173847..... | 12                | 10      | 3.1                       | 3                              |
| Average ... | 11.66+            | 9.5     | 3.1                       | 2.95                           |

The other lot, Cat. No. 173846, U. S. National Museum, contains one perfect specimen and some fragments collected by the donor, J. H. Ferris, at Fort Bowie, Arizona. The perfect specimen has 11 whorls, and measures: length, 9.2 mm.; diameter of eighth whorl, 3.2 mm.; diameter of penultimate whorl, 3 mm.

**LIOSTEMMA**, new subgeneric name.

The species *Holospira (Haplostemma) mearnsi* Dall was given as the type of *Haplostemma* Dall. *Holospira mearnsi* Dall, however, has a subobsolete submedian fold on the axis, running throughout the spire, which places this species in the subgenus *Bostrichocentrum*. *H. (Haplostemma) hamiltoni* Dall would have served better as the type of the group, which is now rechristened *Liostemma*, having as type *H. (Liostemma) hamiltoni* Dall. This subgenus is distinguished from *Bostrichocentrum* by having the pillar smooth, without twist or fold, except in the penultimate whorl, where there is a short, stout, axial lamella.

**HOLOSPIRA (LIOSTEMMA) HAMILTONI** Dall.

There are 8 perfect and 1 young specimen of this species in the collection of the U. S. National Museum, Cat. No. 107759, which were collected by James M. Hamilton, on Selaginella, in the Rio Grande Mountains, Brewster County, Texas, at an altitude of 3,500 feet.

The following table gives measurements of the 8 specimens:

*Measurements of Holospira (Liostemma) hamiltoni.*

| Number.               | Number of whorls. | Length.    | Diameter of ninth whorl. | Diameter of penultimate whorl. |
|-----------------------|-------------------|------------|--------------------------|--------------------------------|
|                       |                   | <i>mm.</i> | <i>mm.</i>               | <i>mm.</i>                     |
| 107759 <i>a</i> ..... | 13.5              | 22         | 5.1                      | 4.4                            |
| 107759 .....          | 12.5              | 19.3       | 5                        | 4.5                            |
| 107759 .....          | 12.5              | 19.7       | 5.1                      | 4.5                            |
| 107759 .....          | 12.5              | 19         | 4.8                      | 4                              |
| 107759 .....          | 12.5              | 19.5       | 5                        | 4.2                            |
| 107759 .....          | 13                | 19.8       | 4.8                      | 4                              |
| 107759 .....          | 13                | 20         | 5                        | 4.2                            |
| 107759 .....          | 13                | 20         | 4.9                      | 4.2                            |
| Average .....         | 12.8              | 19.9       | 4.96                     | 4.25                           |
| Largest .....         | 13.5              | 22         | 5.1                      | 4.5                            |
| Smallest .....        | 12.5              | 19         | 4.8                      | 4                              |

*a* Type.

**HOLOSPIRA (LIOSTEMMA) DURANGOENSIS, new species.**

Plate III, fig. 8.

Shell very large, solid, cylindric-conic, white. Nuclear whorls 2, large, inflated, minutely granulose. Succeeding whorls moderately rounded. Terminal cone gently tapering. The whorls are crossed by numerous very oblique, obsolete threads, which are a little more distinct on the early whorls than the rest, and become practically altogether lost on the cylindrical part of the spire. The penultimate whorl becomes decidedly narrowed basally, and is crossed by a series of quite distinct riblets, which are more strongly developed below the slightly angulated periphery and on the rounded base than near the summit. Base deeply rimate. Last whorl decidedly disjunct; the union of the parietal and outer wall is marked by a slender carina, which extends from behind the peristome to the point of dissolution. The entire free portion is marked by more or less regular, circular threads, which become weak and closely crowded behind the peristome. Aperture roughly circular, with a *very broadly expanded*, but not reflected, peristome. Internal pillar slender, of uniform width in the cylindrical part, somewhat wider in the terminal cone, hollow, smooth, without twist or fold, except in the penultimate turn, where a low cord encircles it a little above the floor.

This is the largest of the known *Holospira*.



There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 187981, which were received from Prof. A. L. Herrera. They were collected at Durango, Durango, Mexico.

*Measurements of Holospira (Liostemma) durangoensis.*

| Number of whorls. | Length | Diameter of ninth whorl. | Diameter of penultimate whorl. |
|-------------------|--------|--------------------------|--------------------------------|
|                   | mm.    | mm.                      | mm.                            |
| a 12              | 34.5   | 8.8                      | 8                              |
| 12                | 33     | 8.9                      | 8.1                            |

a Type.

**HOLOSPIRA (LIOSTEMMA) YUCATANENSIS, new species.**

Plate III, fig. 2.

Shell cylindric-conic, having the greatest diameter at the whorl next to the termination of the terminal cone, with the cylindrical portion gently tapering toward the base, flesh colored, with horn-brown apex. Nuclear whorls two, well rounded, shining, very minutely granulose. Whorls of the evenly tapering terminal cone moderately rounded, early one crossed by regular, well marked, oblique riblets, which gradually decrease in strength on the later whorls, and become quite obsolete on the somewhat flattened turns of the cylindrical part of the spire, which are marked by irregular lines of growth only. On the narrow penultimate whorl the riblets are again present, forming slender curved white threads, which are about one-third as wide as the spaces between them, and extend prominently over the angulated periphery and short rounded base into the narrow umbilical rimation. Last whorl shortly free, the free portion slightly angulated at the junction of the parietal and outer wall, marked by the continuous riblets, which become decidedly crowded behind the peristome. Aperture subcircular, with decidedly expanded, broad, flat, not reflexed, white peristome. Internal pillar hollow throughout, of uniform size from the third to last whorl posteriorly to the terminal cone, where it becomes somewhat enlarged. In the penultimate whorl it is less wide than in the preceding volution and encircled by a moderately well developed slightly submedian lamella. In the last whorl the pillar is quite slender and decidedly oblique.

There is one perfect and one broken specimen in the U. S. National Museum, Cat. No. 187980, which were collected by E. W. Nelson and E. A. Goldman, at Mujeres Island, Yucatan, Mexico. The perfect specimen, the type, has 12 whorls and measures: Length, 18.1 mm.; diameter of ninth whorl, 5.9 mm.; diameter of penultimate whorl, 4.9 mm.

## HOLOSPIRA (HAPLOCION) PASONIS Dall.

Of this, the type species of the subgenus *Haplocion*, the U. S. National Museum collection has 3 lots. Two, Cat. No. 129032, U.S.N.M., the type lot, and Cat. No. 134210, U.S.N.M., two specimens, were collected in Mule Canyon, El Paso County, Texas, at an altitude of 4,000 feet, by J. A. Singley. The third lot, Cat. No. 152642, U.S.N.M., 12 specimens, was collected by Dr. T. W. Stanton, at Red Bull Canyon, El Paso County, Texas. The following table gives the measurements of the perfect specimens:

Measurements of *Holospira* (*Haplocion*) *pasonis*.

| Cat. No.                  | Number of whorls. | Length. | Diameter of ninth whorl. | Diameter of penultimate whorl. |
|---------------------------|-------------------|---------|--------------------------|--------------------------------|
|                           |                   | mm.     | mm.                      | mm.                            |
| 129032 <sup>a</sup> ..... | 11.5              | 22.5    | 6.7                      | 6.2                            |
| 129032 .....              | 12                | 22.7    | 6.2                      | 5.6                            |
| 129032 .....              | 11                | 23      | 6.8                      | 6.3                            |
| 134210 .....              | 12                | 24.6    | 6.8                      | 6.3                            |
| 134210 .....              | 12                | 22.7    | 6.5                      | 6                              |
| 152642 .....              | 12                | 24.7    | 6.6                      | 6.4                            |
| 152642 .....              | 12                | 23.7    | 6.8                      | 6.6                            |
| 152642 .....              | 12                | 22.3    | 6.3                      | 6.1                            |
| 152642 .....              | 12                | 23.8    | 6.6                      | 6.2                            |
| 152642 .....              | 12                | 24.6    | 6.4                      | 6.1                            |
| 152642 .....              | 11.5              | 22.6    | 6.5                      | 6.3                            |
| 152642 .....              | 12                | 23.3    | 6.7                      | 6.2                            |
| 152642 .....              | 12                | 22.9    | 6.3                      | 5.7                            |
| 152642 .....              | 12                | 24.2    | 6.6                      | 6.3                            |
| 152642 .....              | 12                | 22.5    | 6.4                      | 6.2                            |
| Average ...               | 11.86             | 23.34   | 6.54                     | 6.16                           |
| Largest ...               | 12                | 24.7    | 6.8                      | 6.4                            |
| Smallest ...              | 11                | 22.3    | 6.2                      | 5.6                            |

<sup>a</sup> Type.

## HOLOSPIRA (HAPLOCION) SEMISCUPTA Stearns.

There are three specimens in the type lot, Cat. No. 102310, U.S.N.M., which were collected by Dr. T. W. Stanton in the canyon above San Carlos, Chihuahua, Mexico.

Measurements of *Holospira* (*Haplocion*) *semisculpta*.

| Number of whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|--------------------------|--------------------------------|
|                   | mm.     | mm.                      | mm.                            |
| 14                | 22.2    | 5.8                      | 5                              |
| 14                | 23.1    | 6                        | 4.6                            |
| 14                | -----   | 5.6                      | 4.6                            |

## HOLOSPIRA (HAPLOCION) COAHUILENSIS W. G. Binney.

There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 9150, one perfect, the type, and the other a half-grown individual. They were collected by Xantus at

Cienaga Grande, Coahuila, Mexico. The perfect specimen has 12 whorls and measures: Length, 23 mm.; diameter of eighth whorl, 6.5 mm.; diameter of penultimate whorl, 5.6 mm.

**HOLOSPIRA (HAPLOCION) MINIMA** von Martens.

There are two lots of this species in the collection of the U. S. National Museum. One, Cat. No. 126124, U.S.N.M., collected by G. Eisen, in Sonora, Mexico, contains 5 specimens. The other, Cat. No. 56960, U.S.N.M., 6 specimens, donated by W. M. Gabb, comes from Hermosillo, Sonora, Mexico. These specimens give the following measurements:

*Measurements of Holospira (Haplocion) minima.*

| Cat. No.     | Number of whorls. | Length.    | Diameter of ninth whorl. | Diameter of penultimate whorl. |
|--------------|-------------------|------------|--------------------------|--------------------------------|
|              |                   | <i>mm.</i> | <i>mm.</i>               | <i>mm.</i>                     |
| 126124.....  | 12                | 13.3       | 4.7                      | 4.2                            |
| 126124.....  | 12                | 13.3       | 4.2                      | 4                              |
| 126124.....  | 12                | 13         | 4.2                      | 3.9                            |
| 56960.....   | 12                | 13.4       | 4.4                      | 4                              |
| 56960.....   | 12                | 13.4       | 4.1                      | 3.9                            |
| 56960.....   | 12.5              | 14.6       | 4.6                      | 4                              |
| 56960.....   | 12                | 13.6       | 4.5                      | 4.1                            |
| 56960.....   | 11.5              | 11.8       | 4.8                      | 4.5                            |
| 56960.....   | 12                | 12.7       | 4.2                      | 4                              |
| Average...   | 12                | 13.23      | 4.41                     | 4.06                           |
| Largest....  | 12.5              | 14.6       | 4.8                      | 4.5                            |
| Smallest.... | 11.5              | 11.8       | 4.1                      | 3.9                            |

**HOLOSPIRA (HAPLOCION) TOWNSENDI**, new species.

Plate IV, fig. 13.

Shell white, cylindric-conic. Nuclear whorls two, very large, projecting decidedly beyond the outline of the spire. The first of these is large, inflated, and well rounded. The second is a little more depressed and decidedly keeled in the middle. Terminal cone long and gently tapering, composed of the seven whorls succeeding the nucleus. These whorls are somewhat overhanging, well rounded and ornamented by many equal and equally spaced obliquely backward curved ribs. Whorls of the cylindrical portion well rounded, having the ribs a little more distantly spaced on the anterior than the posterior volution. There appear to be about 38 ribs upon the third whorl (i. e., the first postnuclear whorl), 60 upon the tenth and 38 upon the penultimate volution. Sutures well impressed. Periphery of the last turn angulated, having the ribs somewhat strengthened at this place. Base quite short, rounded, marked by the continuation of the ribs, which taper gradually as they pass into the rather deep umbilical rimation. Last portion of last whorl very shortly free, the expanded portion of the peristome almost touching the outer wall of the preceding turn. Aperture almost circular, with a broadly ex-

panded, flattened, but not revolute peristome. Internal column thin, hollow throughout, smooth, marked only by lines of growth, somewhat oblique and contracted in the last whorl, wider in the penultimate and increasing gently in diameter posteriorly to the beginning of the terminal cone. The column in its widest place is equal to about one-fourth of the diameter of the shell. The unique type has 15 whorls and measures: Length, 16 mm.; diameter of eleventh whorl, 4.5 mm.; diameter of penultimate whorl, 4.2 mm.

The type, Cat. No. 109215, U.S.N.M., was collected by C. H. T. Townsend, at Cerro Chilicote, Chihuahua, Mexico.

**HOLOSPIRA (HAPLOCION) FUSCA** von Martens.

There are three specimens of this species in the collection of the U. S. National Museum, Cat No. 162323, U.S.N.M., collected by Godman, at Omilteme, Guerrero, Mexico. The two perfect specimens measure:

*Measurements of Holospira Haplocion fusca.*

| Number of Whorls. | Length. | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|---------|--------------------------|--------------------------------|
|                   | mm.     | mm.                      | mm.                            |
| 17                | 12.8    | 3.8                      | 3.2                            |
| 17                | 12.6    | 3.8                      | 3.1                            |

**HOLOSPIRA (HAPLOCION) LICHENOPHORA**, new species.

Plate IV, fig. 7.

Shell cylindric-conic, dark horn brown, beautifully variegated with irregular white blotches, which appear as white incrustations upon the brown background when examined under the microscope. Nuclear whorls moderately rounded, very minutely granulose, scarcely differentiated from the succeeding turns. Terminal cone gently tapering, having the whorls moderately rounded and marked with ill defined and irregularly spaced riblets. The whorls of the cylindrical portion are moderately rounded, and have the greatest convexity a little posterior to the middle, which lends them a somewhat shouldered appearance. The riblets on the cylindrical part of the spire are represented by mere lines of growth. Sutures decidedly impressed. Last whorl with the lines of growth strengthened, scarcely ribbed, periphery slightly angulated. Base short, well rounded, marked by the strong lines of growth which extend into the moderately broad, open, umbilicus. Last whorl decidedly free at its extremity. The free portion is a little more than 2 mm. wide at the decidedly angulated junction of the parietal and outer wall. The junction of the columellar and parietal wall is also somewhat angulated and the parietal wall itself is not flat,



but somewhat sinuous. The entire free portion is encircled by strong lines of growth, which as usual become weaker and more crowded behind the peristome. Aperture small, oblique, broadly oval, the parietal wall representing the short diameter of the oval. Peristome very thin, moderately expanded and somewhat reflexed. Internal pillar large, about one-fifth the diameter of the shell, straight and narrowed to less than half the diameter in the last whorl, thin, marked only by whitish lines of growth. There are three specimens of this species in the collection of the U. S. National Museum, Cat. No. 134699, collected by E. W. Nelson at Encarnacion, Hidalgo, Mexico. The perfect specimen, the type, has 17 whorls and measures: Length 15.2 mm.; diameter of thirteenth whorl, 4.2 mm.; diameter of penultimate whorl, 4 mm.

**HOLOSPIRA (HAPLOCION) TANTALUS, new species.**

Plate III, fig. 6.

Shell small, pupoid, yellowish white. Nuclear whorls one and one-half, well rounded, very minutely granulose. Terminal cone gently tapering, having the sloping whorls somewhat overhanging; whorls of the cylindrical portion of the spire moderately rounded. The entire post-nuclear spire is marked by feeble, obliquely backward slanting riblets, which are better developed and a little more distantly spaced on the terminal cone and the last two volutions than on the middle of the spire. There are about 52 of these riblets upon the third whorl, about 100 upon the seventh and about 85 upon the penultimate turn. Sutures well marked. Periphery of the last whorl slightly angulated. Base short, well rounded, deeply rimate, marked by the little riblets. Last whorl scarcely free, the peristome adnate to the outer wall of the preceding volution. Aperture moderately large, subcircular, with a decidedly thickened white peristome, which is broadly expanded and very slightly reflected. Internal column slender, straight, increasing gradually in diameter from the last whorl to the early whorls of the terminal cone, smooth, marked only by whitish lines of growth.

There are two specimens of this species in the collection of the U. S. National Museum Cat. No. 29303. They were collected by Dr. Edward Palmer somewhere in Arizona or New Mexico. They have been cited in several places as *Holospira pilsbryi* Dall, but their internal structure, as well as other features, mark them as quite distinct. The two specimens measure:

*Measurements of Holospira (Haplocion) tantalus.*

| Number of whorls. | Length.     | Diameter of eighth whorl. | Diameter of penultimate whorl. |
|-------------------|-------------|---------------------------|--------------------------------|
| $\alpha$ 11       | mm.<br>10.2 | mm.<br>3.3                | mm.<br>3.1                     |
| 11                | 8.3         | 3.2                       | 3.1                            |

 $\alpha$  Type.**HOLOSPIRA (METASTOMA) ROEMERI Pfeiffer.**

There are twelve lots, 47 specimens, in the collection from diverse localities. The extent of their variation in size, etc., is noted in the subjoined table.

*Measurements of Holospira (Metastoma) roemeri.*

| Cat. No.      | Number of whorls. | Length. | Diameter of eighth whorl. | Diameter of penultimate whorl. | Locality.                                                                                        | Collector.                       |
|---------------|-------------------|---------|---------------------------|--------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------|
|               |                   | mm.     | mm.                       | mm.                            |                                                                                                  |                                  |
| 123769.....   | 12                | 11      | 3.8                       | 3.3                            | New Braunfels.....                                                                               | Gurley.                          |
| 39081.....    | 13                | 13      | 4                         | 3.6                            | Bexar County.....                                                                                | J. G. Wetherby.                  |
| 126418.....   | 14                | 13.8    | 4                         | 3.5                            | Helotes, Bexar County.....                                                                       | Do.                              |
| 126418.....   | 12                | 12.1    | 4.2                       | 3.8                            | do.....                                                                                          | Do.                              |
| 188176.....   | 12                | 11.9    | 4                         | 3.3                            | Japonica, Kerr County.....                                                                       | M. Surber.                       |
| 188178.....   | 14                | 14.1    | 4                         | 3.5                            | Headwaters of Nueces River, Edwards County, and Round Mount, on Uvalde River, Uvalde County..... | T. W. Stanton and T. W. Vaughan. |
| 188178.....   | 13                | 12.8    | 4.5                       | 3.7                            | do.....                                                                                          | Do.                              |
| 188178.....   | 14                | 14      | 4.1                       | 3.2                            | do.....                                                                                          | Do.                              |
| 188178.....   | 14                | 13.8    | 4.2                       | 3.3                            | do.....                                                                                          | Do.                              |
| 188178.....   | 14                | 12.8    | 4                         | 3.5                            | do.....                                                                                          | Do.                              |
| 152940.....   | 13                | 12.8    | 4.2                       | 3.5                            | Edwards County.....                                                                              | T. W. Vaughan.                   |
| 152940.....   | 13                | 13.3    | 4                         | 3.3                            | do.....                                                                                          | Do.                              |
| 188174.....   | 13                | 12.5    | 4.2                       | 3.2                            | 13 miles south of Juno, Valverde County.....                                                     | M. Surber.                       |
| 188174.....   | 13                | 13.3    | 4.1                       | 3.2                            | do.....                                                                                          | Do.                              |
| 118393.....   | 13                | 13.3    | 4.8                       | 4.1                            | Devils River.....                                                                                | Lloyd.                           |
| 160844.....   | 15                | 17      | 4.5                       | 4                              | Near Pecos high bridge, in canon of Pecos River, Val Verde County.....                           | F. M. Bailey.                    |
| 160844.....   | 15                | 15.3    | 4.5                       | 4                              | do.....                                                                                          | Do.                              |
| 160844.....   | 15                | 15.6    | 4.5                       | 3.6                            | do.....                                                                                          | Do.                              |
| 160844.....   | 15                | 17      | 4.5                       | 3.7                            | do.....                                                                                          | Do.                              |
| 160844.....   | 15                | 15.8    | 4.7                       | 3.5                            | do.....                                                                                          | Do.                              |
| 160844.....   | 12                | 12.2    | 4.5                       | 3.4                            | do.....                                                                                          | Do.                              |
| 118388.....   | 16                | 17.2    | 4.3                       | 3.6                            | Painted Cave, Pecos River, Valverde County.....                                                  | Lloyd.                           |
| 118388.....   | 14                | 13.5    | 4.3                       | 3.5                            | do.....                                                                                          | Do.                              |
| 188177.....   | 15                | 14.5    | 4.2                       | 3.5                            | Near Spofford.....                                                                               | T. W. Stanton.                   |
| 188177.....   | 14                | 13      | 4                         | 3.5                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 12.5    | 4.2                       | 3.5                            | do.....                                                                                          | Do.                              |
| 188177.....   | 14                | 13.8    | 4.1                       | 3.4                            | do.....                                                                                          | Do.                              |
| 188177.....   | 14                | 13.7    | 4.3                       | 3.7                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 12      | 4                         | 3.3                            | do.....                                                                                          | Do.                              |
| 188177.....   | 14                | 13.5    | 4.2                       | 3.3                            | do.....                                                                                          | Do.                              |
| 188177.....   | 12                | 11.7    | 3.8                       | 3.3                            | do.....                                                                                          | Do.                              |
| 188177.....   | 15                | 15.1    | 3.9                       | 3.4                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 12      | 3.8                       | 3.2                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 13.2    | 3.8                       | 3.2                            | do.....                                                                                          | Do.                              |
| 188177.....   | 14                | 14      | 4                         | 3.2                            | do.....                                                                                          | Do.                              |
| 188177.....   | 14                | 14.2    | 3.7                       | 3.2                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 13.1    | 3.8                       | 3.3                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 13.2    | 3.7                       | 3.2                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 12.6    | 4.1                       | 3.3                            | do.....                                                                                          | Do.                              |
| 188177.....   | 13                | 13      | 4.1                       | 3.6                            | do.....                                                                                          | Do.                              |
| Average.....  | 13.6              | 13.58   | 4.14                      | 3.46                           |                                                                                                  |                                  |
| Largest.....  | 16                | 17.2    | 4.8                       | 4.1                            |                                                                                                  |                                  |
| Smallest..... | 12                | 11      | 3.7                       | 3.2                            |                                                                                                  |                                  |

**HOLOSPIRA (CÆLOSTEMMA) ELIZABETHÆ** Pilsbry.

There are 3 lots in the collection, 20 specimens, all from Amula, which has an altitude of about 6,000 feet and lies between Tixtla and Chilapa, in the State of Guerrero, Mexico. The specimens give the following measurements:

*Measurements of Holospira (Cælostemma) elizabethæ.*

| Cat. No.    | Number of whorls. | Length.    | Diameter of twelfth whorl. | Diameter of penultimate whorl. | Collector.       | Donor.         |
|-------------|-------------------|------------|----------------------------|--------------------------------|------------------|----------------|
|             |                   | <i>mm.</i> | <i>mm.</i>                 | <i>mm.</i>                     |                  |                |
| 101868..... | 21                | 19.7       | 5.7                        | 4.9                            | H. H. Smith..... | H. A. Pilsbry. |
| 101868..... | 19                | 17.3       | 5.6                        | 4.9                            | .....do.....     | Do.            |
| 101868..... | 18                | 15         | 5.4                        | 4.5                            | .....do.....     | Do.            |
| 149600..... | 20                | 19.1       | 6                          | 5                              | .....do.....     | Do.            |
| 149600..... | 19                | 17.5       | 6.1                        | 5.2                            | .....do.....     | Do.            |
| 149600..... | 18                | 16.1       | 5.8                        | 4.5                            | .....do.....     | Do.            |
| 162322..... | 21                | 19.2       | 5.5                        | 4.8                            | Godman.....      | Godman.        |
| 162322..... | 20                | 17.3       | 5.2                        | 4.6                            | .....do.....     | Do.            |
| 162322..... | 20                | 19.2       | 5.6                        | 4.9                            | .....do.....     | Do.            |
| 162322..... | 19                | 17.7       | 5.7                        | 5.2                            | .....do.....     | Do.            |
| 162322..... | 19                | 17.7       | 5                          | 4.8                            | .....do.....     | Do.            |
| 162322..... | 18                | 16.4       | 5.2                        | 4.3                            | .....do.....     | Do.            |
| 162322..... | 19                | 17.4       | 5.1                        | 4.4                            | .....do.....     | Do.            |
| 162322..... | 18                | 16.3       | 5.4                        | 4.4                            | .....do.....     | Do.            |
| 162322..... | 18                | 14.9       | 5.6                        | 4.8                            | .....do.....     | Do.            |
| 162322..... | 18                | 15.6       | 5.7                        | 4.4                            | .....do.....     | Do.            |
| 162322..... | 17                | 15.1       | 5.1                        | 4.7                            | .....do.....     | Do.            |
| 162322..... | 18                | 15.3       | 5.5                        | 4.7                            | .....do.....     | Do.            |
| 162322..... | 16                | 13.7       | 5.5                        | 4.9                            | .....do.....     | Do.            |
| Average..   | 18.73+            | 16.87—     | 5.21+                      | 4.73+                          |                  |                |
| Largest..   | 21                | 19.7       | 6.1                        | 5.2                            |                  |                |
| Smallest..  | 16                | 13.7       | 5                          | 4.3                            |                  |                |

**HOLOSPIRA (CÆLOSTEMMA) DALLI** Pilsbry.

There are 76 specimens of this species in the collection of the U. S. National Museum, Cat. No. 188179, which were collected with the type by E. W. Nelson in the Sierra Guadalupe, Mexico, at an altitude of 9,500 feet, not 6,500, as stated by Dr. Pilsbry.<sup>a</sup> The subjoined table gives a list of measurements of 25 specimens selected to show the limits of variations in length, diameter, and number of whorls.

<sup>a</sup> Manual of Conchology, XV, 1904, p. 101.

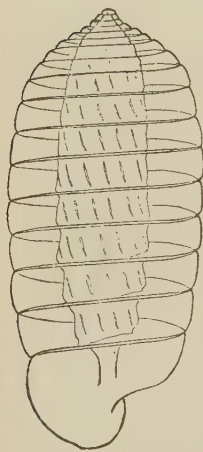
*Measurements of Holospira (Cœlostemma) dalli.*

| Cat. No.     | Number of whorls. | Length.    | Diameter of twelfth whorl. | Diameter of penultimate whorl. |
|--------------|-------------------|------------|----------------------------|--------------------------------|
|              |                   | <i>mm.</i> | <i>mm.</i>                 | <i>mm.</i>                     |
| 188179.....  | 22                | 18.7       | 4.5                        | 4.3                            |
| 188179.....  | 23                | 19.6       | 4.9                        | 4.2                            |
| 188179.....  | 22                | 17.5       | 4.2                        | 4.1                            |
| 188179.....  | 20                | 17.9       | 4.4                        | 4.2                            |
| 188179.....  | 21                | 18         | 5                          | 4.4                            |
| 188179.....  | 20.5              | 18.5       | 5                          | 4.7                            |
| 188179.....  | 21                | 18.3       | 4.5                        | 4.4                            |
| 188179.....  | 22.5              | 18.3       | 4.7                        | 4.8                            |
| 188179.....  | 20                | 16.6       | 4.5                        | 4.2                            |
| 188179.....  | 23                | 18.2       | 4.7                        | 4.1                            |
| 188179.....  | 22                | 16.5       | 5                          | 4.2                            |
| 188179.....  | 23                | 17.5       | 5                          | 4.6                            |
| 188179.....  | 21                | 16.9       | 5.3                        | 4.6                            |
| 188179.....  | 20                | 17.2       | 5.3                        | 5.3                            |
| 188179.....  | 19                | 16         | 5.4                        | 4.8                            |
| 188179.....  | 21                | 17.4       | 5.4                        | 4.7                            |
| 188179.....  | 21                | 17         | 5.4                        | 4.7                            |
| 188179.....  | 19                | 15.7       | 5                          | 4.5                            |
| 188179.....  | 20                | 16         | 5.5                        | 4.8                            |
| 188179.....  | 19                | 16         | 5.3                        | 4.7                            |
| 188179.....  | 19                | 14.6       | 4.6                        | 4.1                            |
| 188179.....  | 18                | 14.1       | 4.6                        | 4.3                            |
| 188179.....  | 17                | 14.3       | 5                          | 4.6                            |
| 188179.....  | 17                | 15         | 5.1                        | 5                              |
| 188179.....  | 18                | 14.4       | 5.3                        | 4.8                            |
| Average...   | 20.36             | 16.84      | 4.94+                      | 4.52+                          |
| Largest....  | 23                | 19.6       | 5.5                        | 5.3                            |
| Smallest.... | 17                | 14.1       | 4.2                        | 4.1                            |

**HOLOSPIRA (CÆLOSTEMMA) HERRERÆ, new species.**

Plate IV, fig. 14.

Shell rather large, broadly club shaped, bluish flesh colored. Nuclear whorls one and one-half, minutely granulose, light horn yellow. Terminal cone short, increasing very rapidly in width. The first two whorls succeeding the nucleus light brown, the rest bluish white. The greatest diameter of the shell coincides with about the tenth whorl, from this the spire tapers very gradually anteriorly to the penultimate turn. The first two or three turns are marked by quite regular, oblique riblets, but these soon give way to mere irregularly developed lines of growth on the succeeding volutions. The whorls of the terminal cone are well rounded, while those of the cylindrical portion of the spire are almost flattened. Sutures weak, appearing as lightly impressed lines. On the penultimate whorl the lines of growth become stronger, forming poorly defined riblets. Periphery of the penultimate whorl decidedly angulated. Base of the last whorl short, brown, minutely punctured in the type (deeply rimate in the second specimen) crossed by the riblets, which are much better developed here than on the

FIG. 10.—INTERIOR VIEW OF *HOLOSPIRA* HERRERÆ.

crossed by the riblets, which are much better developed here than on the



spire, and continue into the perforation. Last whorl free at its anterior extremity for about  $1\frac{1}{2}$  mm., the free portion marked by rings of riblets, which become crowded behind the peristome. Free portion of the parietal wall somewhat sinuous. Junction of the parietal and outer wall slightly obtusely angulated. Aperture moderately large, brown within, semioval, the short diameter of the oval being represented by the parietal wall. Peristome decidedly expanded, and somewhat reflected, edged with white. Internal column very large, about one-half the greatest diameter of the shell in its widest part, widest near the terminal cone, tapering gradually anteriorly. In the penultimate whorl it is only about one-half as wide as it is at the junction of the cylindrical portion of the spire with the terminal one. In the last whorl it is much narrower and smooth. The column is thin, semi-transparent, marked by thread-like riblets, which extend from the roof of the whorls to the floor. There are about twenty-four of these riblets in the penultimate and thirty-two in the twelfth whorl. In addition to the riblets the column has a weak spiral fold, which is situated a little above the floor. There is also a tendency to form nodules at the place where the riblets cross this fold.

There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 188180. They were donated by Prof. A. L. Herrera, and come from Silaca Yoapan, Oaxaca, Mexico.

*Measurements of Holospira (Caelostemma) herrerae.*

| Number of whorls. | Length.  | Diameter of tenth whorl. | Diameter of penultimate whorl. |
|-------------------|----------|--------------------------|--------------------------------|
| <i>a</i> 17       | mm. 16.7 | mm. 7.4                  | mm. 6                          |
| 18                | 19       | 6.7                      | 5.8                            |

*a* Type.

**STALACTELLA**, new subgenus.

*Holospira* having a spiral swelling on the pillar, which terminates anteriorly in a strong lamella; and a spiral line of slender teeth pending from the parietal wall in the anterior volutions.

*Type*.—*Holospira (Stalactella) rosei*, new species.

**HOLOSPIRA (STALACTELLA) ROSEI**, new species.

Plate IV, fig. 10.

Shell cylindric-conic, white. Nuclear whorls two, more inflated than the succeeding ones, minutely granulose. Terminal cone long, gently tapering, with the whorls well rounded. Whorls of the cylindrical portion flattened, shouldered a little below the summit and

somewhat contracted at the periphery, thus forming decidedly strongly marked sutures. The whorls are crossed by numerous, quite regularly spaced, obliquely backward slanting thread like riblets, which are about one-fifth as wide as the spaces which separate them. These riblets are not as well developed on the middle of the spire as on the anterior and posterior extremity of the shell. Antepenultimate whorl decidedly less high than the preceding or succeeding volution. Base and outer wall of the last whorl pinched to form a low keel at the periphery, which extends back from the peristome over the solute

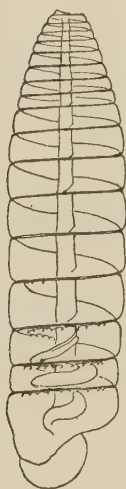


FIG. 11.—INTERIOR VIEW OF HOLOSPIRA ROSEL.

portion. Anterior part of base well rounded, marked by the strong continuation of the riblets, which pass uninterrupted from periphery over the base into the rather broad, open umbilicus. Parietal wall of the free portion somewhat sinuous and pinched a little to the left of the junction with the outer wall. The junction of the parietal and outer wall is marked by a low broad keel that extends over the solute area. Junction of the parietal and columellar wall angular. The entire solute portion is marked by concentric rings of riblets, which become crowded behind the peristome. Aperture irregularly semioval, somewhat contracted in the middle of the outer and parietal wall, having the posterior lateral angle decidedly rounded and forming almost a right angle at the junction of the parietal and columellar walls, well rounded, and somewhat effuse anteriorly, white. Peristome ex-

panded and slightly reflected. Internal column slender, very thin, translucent, showing many oblique white lines of growth and bearing a low keel or swelling, which is located a little posterior to the middle in each whorl. In the last three turns this keel is replaced by a very strong lamella, which attains its maximum development in the middle and gradually decreases in size posteriorly and anteriorly, the attenuated extremity being visible deeply within the aperture on the columellar wall. The greatest width of the lamella is equal to about one-half of the diameter of the whorl and its greatest thickness to a little more than one-fourth of the height of the chamber. In the last three whorls, coextensive with the columellar fold, there is a spiral line of slender, sharp, regularly spaced, forward and outward curved

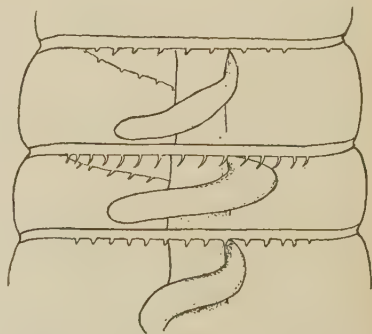


FIG. 12.—DETAIL OF INTERIOR OF HOLOSPIRA ROSEL.

teeth, pending from the parietal wall. These teeth are placed upon a slender raised spiral thread, which disappear anteriorly and posteriorly with the teeth. The teeth are not apparent in the aperture. The internal septa are extremely thin and transparent. The type has 17 whorls (the nucleus and probably the first two of the succeeding turns being lost), and measures: Length, 14.5 mm.; greatest diameter, 3.6 mm.

Two specimens and three fragments of this species, Cat. No. 188181 U.S.N.M., were collected by J. N. Rose and J. H. Painter at Tehuacan, Puebla, Mexico. The other specimen also has the nucleus and a few more of the succeeding whorls, decollated. It has 13 whorls remaining and measures: Length, 12.2 mm.; diameter, 3.6 mm.

#### HENDERSONIELLA Dall.

Shell discoid, with a single internal parietal lamina, the aperture and part of the last whorl free from the disk and recurved so that the holostomatous aperture lies above the disk and with the plane of its margin nearly or quite parallel with the plane of the shell coil. Soft parts resembling those of *Holospira*.

This genus is dedicated to John B. Henderson, jr., known in connection with his studies of the Antillean land shells. It is an animal of the Urocoptid group which has taken upon itself a discoid form, something hitherto unknown in that assembly and therefore of unusual interest.

#### HENDERSONIELLA PALMERI Dall.

*Hendersonia palmeri* DALL, Smith. Misc. Coll. (Quart. Issue), III, 1905, p. 187, pl. XLIV = *Hendersoniella palmeri* DALL, Idem, p. 239.

Plate V, figs. 1-4.

Shell thin, depressed, nearly flat above, with the periphery compressed and keeled; the umbilicus wide, shallow, saucer like, its margin subangular; the suture distinct, rather deep, not channelled but with the whorls between distinctly rounded; nuclear whorl polished, rather prominent, the eight subsequent whorls subequal, closely coiled; the termination of the last whorl divergent, wholly free from the body, curved upward with the aperture nearly or quite in the plane of the surface of the spire, dilated and cup-like toward the aperture, the peristome continuous, expanded, and slightly reflected, with an obscure wave on the proximal side; surface striated with feeble lines of growth, color about that of *Polygyra microdonta* Deshayes, a pale horn color or ashy brown, whitish on the peristome; lumen of the whorls subrectangular before becoming solute; about one-fourth of the last whorl contains a single prominent, somewhat oblique elevated lamina on the body side, which diminishes gradually toward each end, the distal end becoming obsolete about the point where the last whorl leaves the coil and begins to grow independently; the wave in the free portion seems to be a reminiscence of the infold in ordinary *Holospiras*, but is almost

evanescent; diameter, major, 12.5; minor, 9.0; height, 2.0; length of free portion of whorl varying from 1.0 to 3.0 mm. Diameter of aperture, long, 3.0; short, 2.0 mm.

*Habitat.* Alvarez Mountains, San Luis Potosi, at 7,200 feet elevation; Dr. Edward Palmer, of the U. S. Agricultural Dept.

*Type.*—Cat. No. 110385, U.S.N.M.

The remarkable feature of this animal, apart from its discoid form, is the manner in which the termination of the last whorl is freed from the rest and turned upward, as in *Anostoma* or *Hypselostoma*, so that, in crawling, the shell must be dragged on what would ordinarily be the



Fig. 13.



Fig. 14.

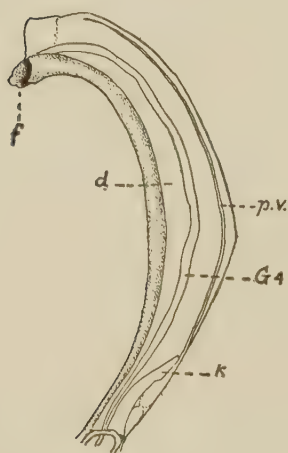


Fig. 15.

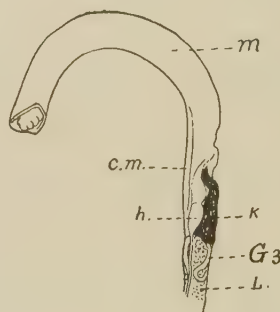


Fig. 16.

FIG. 13.—Sketch of jaw of *Hendersoniella palmeri*.

FIG. 14.—Teeth of radula, showing (1) rhachidian, first three laterals, ninth lateral, and outer lateral.

FIG. 15.—Anatomical details; *k*, kidney; *G 4*, intestine; *p. v.*, pulmonary vein; *d*, lung.

FIG. 16.—*m*, mantle; *c. m.*, contractor muscle, *h*, heart; *k*, kidney; *G 3*, undeveloped genitalia; *L*, liver. All magnified; taken from drawings by Dr. H. A. Pilsbry.

upper surface; a fact which is confirmed by the worn condition in each case of this part of the shell. The aperture strongly recalls that of *Urocoptis*, suggesting at first glance that we have to do with a discoid member of that family. However, the internal lamina and the general aspect of the shell, except the umbilical region, are not very unlike the discoid *Polygyras*.

One of the two specimens containing the animal was submitted to Doctor Pilsbry as the most competent expert in the anatomy of the Pulmonata, who reports as follows:

"The specimen was preserved in alcohol and had retreated somewhat more than one whorl within the aperture. It was opened by dissolving the upper surface of



the shell with acid until the body could be lifted out unbroken. The foot projected shortly from the rather thick collar of the mantle. It is short and proportioned about as in *Holospira*. The narrow lung extends somewhat more than half a whorl. Its surface is plain, without perceptible venation, except for the long pulmonary vein (*p. v.*). The kidney (*K*) is wedge-shaped and but slightly longer than the pericardium, exactly as in *Holospira* as figured in the Manual of Conchology, *Urocoptidae*, pl. 27, fig. 37. It is bright pink and 3 mm. long. There is apparently no secondary ureter, nor is there any groove along the intestine (*G. 4*). The intestine is of the usual four-folded type, and penetrates only a short distance behind the heart and kidney.

The very long liver and the ovotestis occupy the whole of the earlier whorls.

"The genitalia were undeveloped and thread-like. There is a rather long atrium and an excessively long vagina. The penis was represented by a minute bud-like tubercle only, and was evidently not yet developed. Its retractor was not seen if present.

"The jaw is very thin, arcuate with faint, well-spaced vertical striæ, as in *Holospira*. The radula has teeth of the *Holospira* type. The rhachidian and six laterals are unicuspid, the cusps obtuse and as long as the basal plates. The marginal teeth have a small ectocone and the mesocone becomes longer."

In a letter Doctor Pilsbry adds: "This is the most interesting thing which has turned up in Mexico since *Metostrakon*, . . . Your surmise that it was a Urocoptid turns out to be correct. The very short kidney, scarcely longer than the pericardium, alone settles it. These organs, as well as the jaw and teeth, are exactly as in *Holospira*, next to which it evidently belongs."

Since the edition of the original publication of this remarkable species was rather limited, I have considered it advisable to repeat Doctor Dall's description and to give his figures in this connection.

There are eight specimens in the type lot. Six of these are perfect and give the following measurements:

*Measurements of Hendersoniella palmeri.*

| Cat. No.    | Major diameter | Minor diameter | Height.    |
|-------------|----------------|----------------|------------|
|             | <i>mm.</i>     | <i>mm.</i>     | <i>mm.</i> |
| 110385..... | 12.5           | 9              | 2          |
| 110385..... | 13             | 10.1           | 2.5        |
| 110385..... | 12.4           | 9.6            | 2.3        |
| 110385..... | 11.6           | 9.7            | 2.4        |
| 110385..... | 11.5           | 10             | 2.3        |
| 110385..... | 11.5           | 10.1           | 2.3        |
| Average...  | 12.08          | 9.75           | 2.3        |
| Largest.... | 13             | 10.1           | 2.5        |
| Smallest..  | 11.5           | 9              | 2          |

<sup>a</sup>Type.

UROCOPTIS (COCHLODINELLA) POEYANA VARIEGATA Pfeiffer.

There are seven lots, 38 specimens of this form in the collection of the U. S. National Museum from Florida. They come from the following localities and give the measurements of the subjoined table:

*Measurements of Urocoptis (Cochlodinella) poeyana variegata.*

| Cat. No.     | Number of whorls remaining. | Length. | Greatest diameter. | Diameter of penultimate whorl. | Locality.        | Collector or donor. |
|--------------|-----------------------------|---------|--------------------|--------------------------------|------------------|---------------------|
|              |                             | mm.     | mm.                | mm.                            |                  |                     |
| 8698.....    | 10                          | 13.8    | 3.4                | 3                              | Florida.....     | W. G. Binney.       |
| 26555.....   | 9                           | 12.5    | 3.3                | 3                              | do.....          | Do.                 |
| 26555.....   | 9                           | 9.9     | 2.6                | 2.4                            | do.....          | Do.                 |
| 117174.....  | 9                           | 12.3    | 3.4                | 3.2                            | do.....          | A. A. Gould.        |
| 117174.....  | 10                          | 12.8    | 3.8                | 3.4                            | do.....          | Do.                 |
| 117174.....  | 9                           | 13      | 3.4                | 3.2                            | do.....          | Do.                 |
| 117174.....  | 13                          | 14      | 3.4                | 3                              | do.....          | Do.                 |
| 117174.....  | 9                           | 11.8    | 3.3                | 3                              | do.....          | Do.                 |
| 117174.....  | 9                           | 12.5    | 3.4                | 3.2                            | do.....          | Do.                 |
| 117174.....  | 9                           | 12.3    | 3.3                | 3.1                            | do.....          | Do.                 |
| 117174.....  | 9                           | 11.7    | 3.3                | 3                              | do.....          | Do.                 |
| 117174.....  | 9                           | 12.3    | 3.3                | 3                              | do.....          | Do.                 |
| 117174.....  | 9                           | 10.7    | 3.1                | 3                              | do.....          | Do.                 |
| 117174.....  | 8                           | 10.1    | 2.8                | 2.6                            | do.....          | Do.                 |
| 117174.....  | 9                           | 10.1    | 3                  | 2.9                            | do.....          | Do.                 |
| 117189.....  | 10                          | 13      | 3.2                | 3                              | Fort Dallas..... | J. G. Cooper.       |
| 117189.....  | 9                           | 11      | 3                  | 2.9                            | do.....          | Do.                 |
| 36006.....   | 9                           | 11.9    | 3.3                | 3.1                            | Key West.....    | H. Hemphill.        |
| 36006.....   | 9                           | 11.9    | 3.1                | 2.9                            | do.....          | Do.                 |
| 36006.....   | 10                          | 11.4    | 3.1                | 2.8                            | do.....          | Do.                 |
| 36006.....   | 9                           | 11.9    | 3.1                | 2.8                            | do.....          | Do.                 |
| 36006.....   | 9                           | 11.4    | 2.9                | 2.7                            | do.....          | Do.                 |
| 36006.....   | 9                           | 10.8    | 3                  | 2.8                            | do.....          | Do.                 |
| 61221.....   | 10                          | 12.4    | 3.1                | 3                              | do.....          | W. H. Rush.         |
| 61221.....   | 9                           | 11.8    | 3.1                | 2.8                            | do.....          | Do.                 |
| 61221.....   | 10                          | 12.3    | 3.2                | 2.9                            | do.....          | Do.                 |
| 61221.....   | 9                           | 11.5    | 3                  | 2.8                            | do.....          | Do.                 |
| 61221.....   | 10                          | 12.4    | 3                  | 2.8                            | do.....          | Do.                 |
| 61221.....   | 10                          | 11.2    | 2.9                | 2.8                            | do.....          | Do.                 |
| 30669.....   | 9                           | 11.5    | 3.2                | 3                              | Tortugas.....    | Holder.             |
| 30669.....   | 9                           | 12      | 3                  | 2.8                            | do.....          | Do.                 |
| Average....  | 9.45                        | 11.87   | 3.18               | 2.93                           |                  |                     |
| Largest....  | 13                          | 14      | 3.8                | 3.4                            |                  |                     |
| Smallest.... | 9                           | 9.9     | 2.6                | 2.4                            |                  |                     |

**UROCOPTIS (COCHLODINELLA) POEYANA JEJUNA** Gould.

There are two lots of this species in the collection of the U. S. National Museum from Florida, Cat. Nos. 159442, collected by William Offer at Miami, and 117170, five specimens from A. A. Gould, without specific locality.

*Measurements of Urocoptis (Cochlodinella) poeyana jejuna.*

| Cat. No.     | Number of remaining whorls. | Length. | Greatest diameter. | Diameter of penultimate whorl. | Locality.    | Collector or donor. |
|--------------|-----------------------------|---------|--------------------|--------------------------------|--------------|---------------------|
|              |                             | mm.     | mm.                | mm.                            |              |                     |
| 117170.....  | 8                           | 9.4     | 3                  | 2.6                            | Florida..... | A. A. Gould.        |
| 117170.....  | 9                           | 9.9     | 2.6                | 2.2                            | do.....      | Do.                 |
| 117170.....  | 8                           | 9.6     | 2.7                | 2.6                            | do.....      | Do.                 |
| 117170.....  | 8                           | 8.5     | 2.6                | 2.3                            | do.....      | Do.                 |
| 117170.....  | 8                           | 9       | 2.8                | 2.5                            | do.....      | Do.                 |
| 159442.....  | 8                           | 9.2     | 2.8                | 2.6                            | Miami.....   | W. Offer.           |
| 159442.....  | 9                           | 9.7     | 2.7                | 2.6                            | do.....      | Do.                 |
| 159442.....  | 8                           | 10      | 2.8                | 2.6                            | do.....      | Do.                 |
| 159442.....  | 8                           | 9.2     | 2.6                | 2.5                            | do.....      | Do.                 |
| 159442.....  | 9                           | 9.2     | 2.8                | 2.5                            | do.....      | Do.                 |
| Average....  | 8.2                         | 9.37    | 2.74               | 2.5                            |              |                     |
| Largest....  | 9                           | 10      | 3                  | 2.6                            |              |                     |
| Smallest.... | 8                           | 8.5     | 2.6                | 2.2                            |              |                     |

**BRACHYPODELLA MORINI** Morelet.

There are two specimens of this species in the collection of the U. S. National Museum, Cat. No. 32083, collected by Sarg, in Guatemala. Both have lost the apex.

*Measurements of Brachypodella morini.*

| Number of whorls. | Length.    | Greatest diameter. | Diameter of penultimate whorl. |
|-------------------|------------|--------------------|--------------------------------|
|                   | <i>mm.</i> | <i>mm.</i>         | <i>mm.</i>                     |
| 14                | 13.2       | 2.5                | 2.1                            |
| 17                | 13.3       | 2.5                | 2.1                            |

**BRACHYPODELLA BOURGUIGNATIANA** Ancy.

There is one specimen of this species in the collection of the U. S. National Museum, Cat. No. 159594, which has the last ten whorls and measures: Length, 9.6 mm.; greatest diameter, 2.4 mm.; diameter of penultimate whorl, 2.2 mm. The specimen bears the locality label "Honduras."

**MICROCERAMUS PONTIFICUS** Gould.

There are three lots, 15 specimens, in the collection of the U. S. National Museum, which give the following measurements and data:

*Measurements of Microceramus pontificus.*

| Cat. No.     | Number of whorls. | Length.    | Diameter of penultimate whorl. | Locality.       | Collector or donor. |
|--------------|-------------------|------------|--------------------------------|-----------------|---------------------|
|              |                   | <i>mm.</i> | <i>mm.</i>                     |                 |                     |
| 8702.....    | 12                | 12.5       | 4.7                            | Florida.....    | Type.               |
| 117153.....  | 12                | 12         | 4                              | do.....         | Binney coll.        |
| 117153.....  | 12                | 12.5       | 4.4                            | do.....         | Do.                 |
| 117153.....  | 11                | 10.1       | 3.8                            | do.....         | Do.                 |
| 117153.....  | 12                | 12.3       | 4.3                            | do.....         | Do.                 |
| 117153.....  | 11                | 10.8       | 4                              | do.....         | Do.                 |
| 117153.....  | 11.5              | 11.3       | 4.1                            | do.....         | Do.                 |
| 117153.....  | 11                | 10.1       | 3.6                            | do.....         | Do.                 |
| 159435.....  | 11                | 9.5        | 3.8                            | Miami, Fla..... | Wm. Offer.          |
| 159435.....  | 11.5              | 10.5       | 3.6                            | do.....         | Do.                 |
| Average ..   | 11.5              | 11.16      | 4.03                           |                 |                     |
| Largest....  | 12                | 12.5       | 4.7                            |                 |                     |
| Smallest.... | 11                | 9.5        | 3.6                            |                 |                     |

## MICROCERAMUS FLORIDANUS Pilsbry.

There are eight lots of this species in the collection of the U. S. National Museum, 48 specimens in all. Two lots, Cat. Nos. 47484 U. S. N. M., and 188182 U. S. N. M., are labeled Florida, without specific locality. The other six lots furnish the following data:

*Measurements of Microceramus floridanus.*

| Cat. No.      | Number of whorls. | Length. | Diameter of penultimate whorl. | Locality.             | Donor or collector.                  |
|---------------|-------------------|---------|--------------------------------|-----------------------|--------------------------------------|
|               |                   | mm.     | mm.                            |                       |                                      |
| 37631.....    | 10                | 7.9     | 2.9                            | Sarasota Bay.....     | R. E. C. Stearns.                    |
| 37631.....    | 9                 | 6.7     | 2.8                            | do.....               | Do.                                  |
| 37631.....    | 9                 | 7       | 2.7                            | do.....               | Do.                                  |
| 37631.....    | 9                 | 6.3     | 2.7                            | do.....               | Do.                                  |
| 37631.....    | 9.5               | 7.4     | 2.8                            | do.....               | Do.                                  |
| 37631.....    | 9                 | 6.2     | 2.7                            | do.....               | Do.                                  |
| 37631.....    | 9.5               | 7.2     | 2.9                            | do.....               | Do.                                  |
| 37631.....    | 9                 | 6.8     | 2.8                            | do.....               | Do.                                  |
| 30614.....    | 9                 | 8.1     | 3.2                            | do.....               | E. Jewett.                           |
| 30614.....    | 9                 | 8       | 3.2                            | do.....               | Do.                                  |
| 30614.....    | 9                 | 8.1     | 3                              | do.....               | Do.                                  |
| 30614.....    | 10                | 7.8     | 3                              | do.....               | Do.                                  |
| 30614.....    | 9                 | 7.5     | 3.1                            | do.....               | Do.                                  |
| 30614.....    | 10                | 7.9     | 3                              | do.....               | Do.                                  |
| 30614.....    | 10                | 8.2     | 3                              | do.....               | Do.                                  |
| 30614.....    | 10                | 8       | 3.2                            | do.....               | Do.                                  |
| 31644.....    | 10                | 8.8     | 3.3                            | Savata Bay.....       | W. H. Dall.                          |
| 31644.....    | 10                | 8.8     | 3.2                            | do.....               | Do.                                  |
| 124345.....   | 9                 | 7.6     | 3.1                            | Shaws Point, Fla..... | John B. Henderson and C. T. Simpson. |
| 124345.....   | 9                 | 7.8     | 3.1                            | do.....               | Do.                                  |
| 36005.....    | 10                | 9.3     | 3.4                            | Key West, Fla.....    | H. Hemphill.                         |
| 36005.....    | 10                | 8.9     | 3.2                            | do.....               | Do.                                  |
| 36005.....    | 10                | 8.7     | 3.2                            | do.....               | Do.                                  |
| 37695.....    | 10                | 8.3     | 3.2                            | Key Vaccas, Fla.....  | Do.                                  |
| 37695.....    | 9                 | 7.5     | 3.1                            | do.....               | Do.                                  |
| 37695.....    | 9                 | 7.6     | 2.8                            | do.....               | Do.                                  |
| Average.....  | 9.46              | 7.78    | 3.02                           |                       |                                      |
| Largest.....  | 10                | 9.3     | 3.3                            |                       |                                      |
| Smallest..... | 9                 | 6.2     | 2.7                            |                       |                                      |

## MICROCERAMUS TEXASIANUS Pilsbry.

There are four lots, 56 specimens, in the collection of the U. S. National Museum. Three of these, Cat. Nos. 97456, 123766; and 134211, U. S. N. M., come from New Braunfels, Tex. The other, Cat. No. 126419, U. S. N. M., is from Helotes, Bexar County. Subjoined is a list of 20 average specimens from New Braunfels and that of the Helotes individual.



*Measurements of Microceramus texasianus.*

| Cat. No.    | Number of whorls. | Length. | Diameter of penultimate whorl. |
|-------------|-------------------|---------|--------------------------------|
|             |                   | mm.     | mm.                            |
| 123766..... | 10                | 10.2    | 3.8                            |
| 123766..... | 10                | 10      | 3.8                            |
| 123766..... | 10                | 9.7     | 3.7                            |
| 123766..... | 10                | 9.4     | 3.6                            |
| 123766..... | 10                | 10      | 3.7                            |
| 123766..... | 10                | 9.6     | 3.8                            |
| 123766..... | 10                | 9.8     | 3.8                            |
| 123766..... | 10                | 9.7     | 3.7                            |
| 123766..... | 10                | 9.6     | 3.8                            |
| 123766..... | 9.5               | 8.5     | 3.3                            |
| 123766..... | 10                | 10      | 3.5                            |
| 123766..... | 10                | 9.6     | 3.7                            |
| 123766..... | 10                | 10.3    | 3.4                            |
| 123766..... | 10                | 9.8     | 4                              |
| 123766..... | 9                 | 8       | 3.2                            |
| 123766..... | 10                | 9.4     | 3.4                            |
| 123766..... | 10                | 9.3     | 3.7                            |
| 123766..... | 10                | 10.6    | 3.9                            |
| 123766..... | 10                | 10.4    | 3.7                            |
| 123766..... | 10                | 10.2    | 3.7                            |
| Average...  | 9.92              | 9.7     | 3.64                           |
| Largest.... | 10                | 10.6    | 4                              |
| Smallest... | 9                 | 8       | 3.2                            |
| 126419..... | 9                 | 8.6     | 3.3                            |

**MICROCERAMUS MEXICANUS** Pfeiffer.

There are five lots, 24 specimens, of this species in the collection of the U. S. National Museum, which furnish the following data:

*Measurements of Microceramus mexicanus.*

| Cat. No.    | Number of whorls. | Length. | Diameter of penultimate whorl. | Locality.                      | Collector or donor. |
|-------------|-------------------|---------|--------------------------------|--------------------------------|---------------------|
|             |                   | mm.     | mm.                            |                                |                     |
| 172398..... | 9                 | 7.8     | 3.2                            | Victoria.....                  | H. A. Pilsbry.      |
| 172398..... | 9                 | 7.4     | 3.2                            | Tamaulipas.....                | Do.                 |
| 172398..... | 9                 | 7.5     | 3.2                            | do.....                        | Do.                 |
| 172398..... | 9                 | 7.7     | 3.3                            | do.....                        | Do.                 |
| 172398..... | 9                 | 7.8     | 3.4                            | do.....                        | Do.                 |
| 172398..... | 9                 | 7.3     | 3.2                            | do.....                        | Do.                 |
| 110389..... | 10                | 10.2    | 4                              | Alvarez Mts., San Luis Potosi. | E. Palmer.          |
| 110389..... | 10                | 9.5     | 3.8                            | do.....                        | Do.                 |
| 110389..... | 10                | 9       | 3.7                            | do.....                        | Do.                 |
| 110389..... | 9                 | 9.6     | 3.8                            | 7,200 feet altitude.....       | Do.                 |
| 110389..... | 9                 | 9.8     | 3.9                            | do.....                        | Do.                 |
| 160146..... | 9                 | 8.3     | 3.7                            | City of Mexico.....            | Woodworth.          |
| 160146..... | 9                 | 8.4     | 3.5                            | do.....                        | Do.                 |
| 188184..... | 9                 | 8.4     | 3.4                            | Morelos.....                   | Do.                 |
| 24961.....  | 9                 | 7.8     | 3.3                            | Mexico.....                    |                     |
| Average...  | 9.2               | 8.41    | 3.5                            |                                |                     |
| Largest.... | 10                | 10.2    | 4                              |                                |                     |
| Smallest... | 9                 | 7.3     | 3.2                            |                                |                     |

**MICROCERAMUS CONCISUS** Morelet.

There are two lots of this species in the collection of the U. S. National Museum, Cat. No. 188185, from Campeche, Campeche, Mexico, consisting of three specimens collected by E. W. Nelson, and

Cat. No. 162507, U.S.N.M., one specimen from Dr. H. von Ihering, collected at Alta Vera Paz, Guatemala. The latter is decidedly more obese than those from Campeche. The following table gives a list of measurements:

*Measurements of Microceramus concisus.*

| Cat. No.   | Number of whorls. | Length. | Diameter of penultimate whorl. |
|------------|-------------------|---------|--------------------------------|
|            |                   | mm.     | - mm.                          |
| 188185.... | 11                | 11.1    | 3.6                            |
| 188185.... | 11                | 10.1    | 3.1                            |
| 188185.... | 10                | 8.3     | 3.2                            |
| 162507.... | 11                | 11.2    | 4.1                            |

EXPLANATION OF PLATES.

PLATE III.

- FIG. 1. *Anisospira (Dissotropis) stearnsi*. Length 30 mm. p. 113.  
 2. *Holospira (Liostemma) yucatanensis*. Length 18.1 mm. p. 143.  
 3. *Anisospira (Dissotropis) blandi*. Length 33.7 mm. p. 114.  
 4. *Holospira (Holospira) infantia*. Length 9.7 mm. p. 129.  
 5. *Holospira (Holospira) painteri*. Length 8.4 mm. p. 130.  
 6. *Holospira (Haplocion) tantalus*. Length 10.2 mm. p. 147.  
 7. *Cœlocentrum pittieri*. Length 60.7 mm. p. 116.  
 8. *Holospira (Liostemma) durangoensis*. Length 34.5 mm. p. 142.  
 9. *Eucalodium decollatum guatemalensis*. Length 60.9 mm. p. 110.

PLATE IV.

- FIG. 1. *Holospira (Bostrichocentrum) goldmani*. Length 14.9 mm. p. 136.  
 2. *Holospira (Bostrichocentrum) tamaulipensis*. Length 12.5 mm. p. 139.  
 3. *Epirobia coahuilensis*. Length 10.8 mm. p. 121.  
 4. *Holospira (Holospira) goldfussi anacachensis*. Length 12 mm. p. 124.  
 5. *Holospira (Holospira) oaxacana*. Length 17.5 mm. p. 132.  
 6. *Holospira (Holospira) palmeri*. Length 13.7 mm. p. 128.  
 7. *Holospira (Haplocion) lichenophora*. Length 15.2 mm. p. 146.  
 8. *Epirobia (Propilsbrya) nelsoni*. Length 15.2 mm. p. 122.  
 9. *Holospira (Holospira) mexicana*. Length 17.4 mm. p. 127.  
 10. *Holospira (Stalactella) rosei*. Length 12.2 mm. p. 151.  
 11. *Coelocentrum pittieri guatemalensis*. Length 41.8 mm. p. 117.  
 12. *Holospira (Bostrichocentrum) hidalgoensis*. Length 20.5 mm. p. 138.  
 13. *Holospira (Haplocion) townsendi*. Length 16 mm. p. 145.  
 14. *Holospira (Coelostemma) herreræ*. Length 19 mm. p. 150.

PLATE V.

*Hendersoniella palmeri* Dall.

All figures magnified two and one-half diameters.

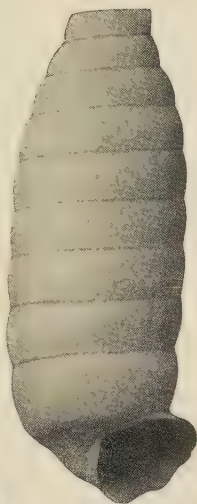
- FIG. 1. View from below. p. 153.  
 2. Profile.  
 3. Specimens with the whorl broken away to show the internal spiral lamina.  
 4. View from above.



1



2



3



4



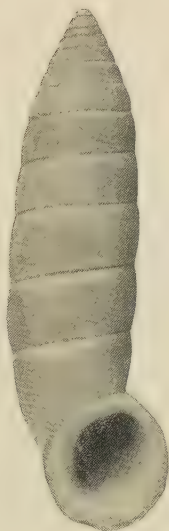
5



6



7



8



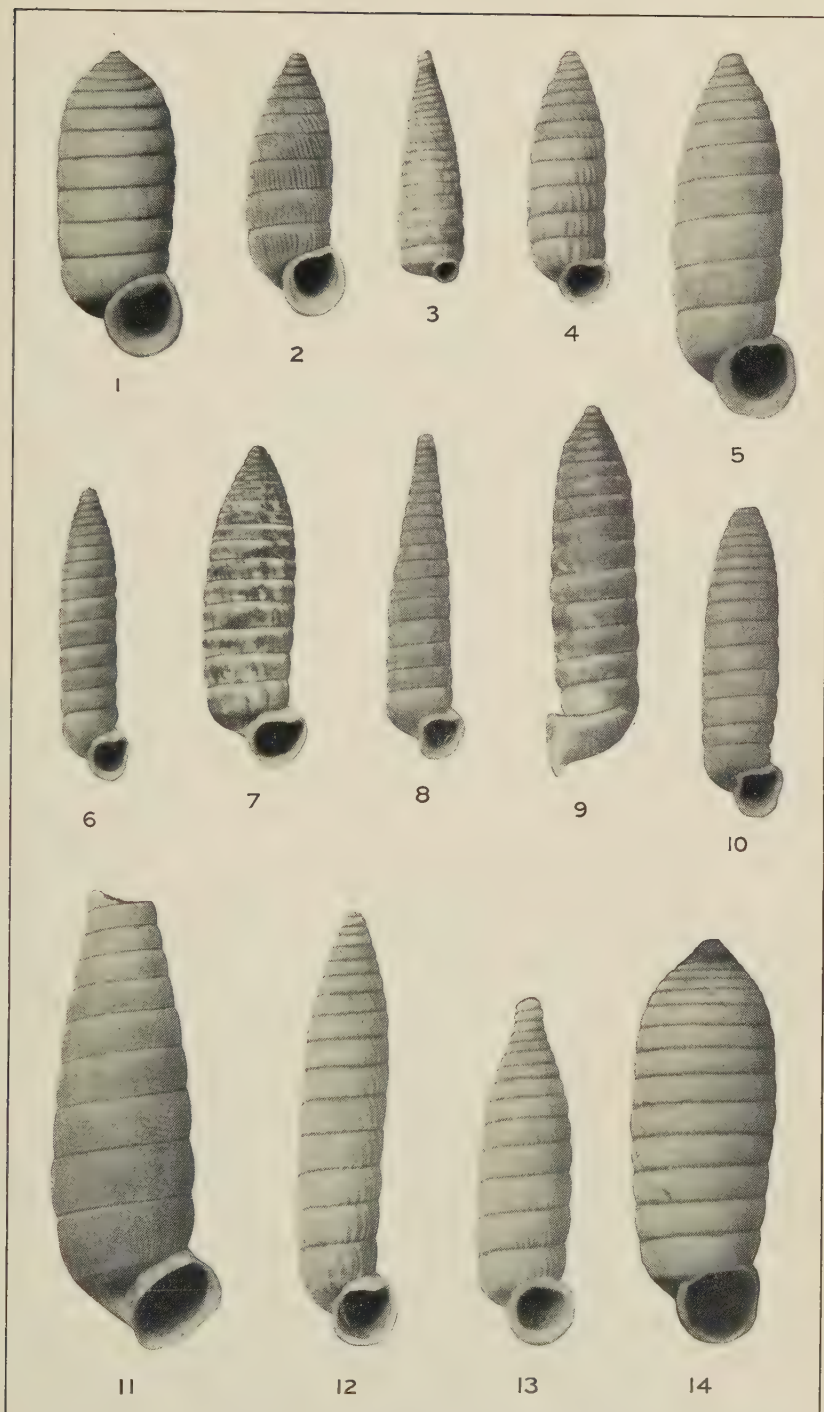
9

NORTH AMERICAN UROCOPTID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 160.



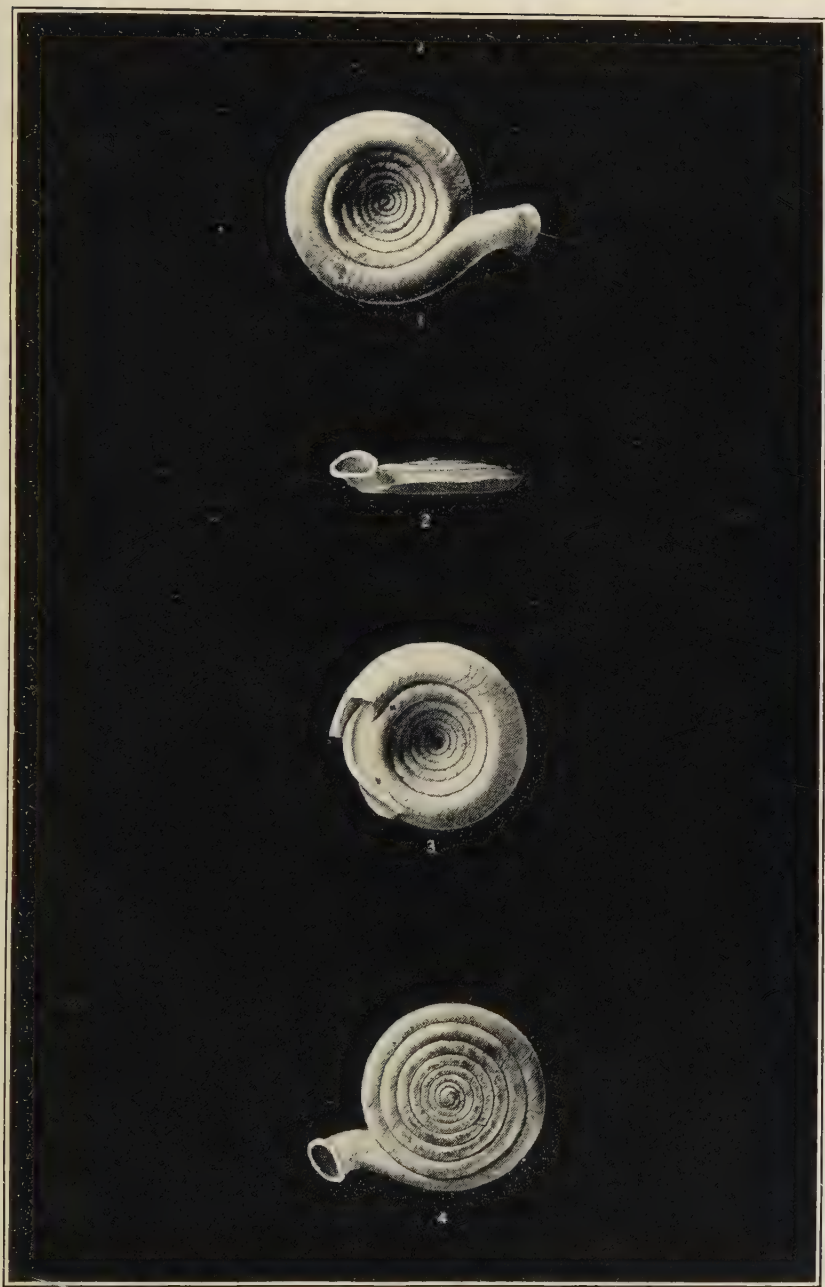




NORTH AMERICAN UROCOPTID MOLLUSKS.

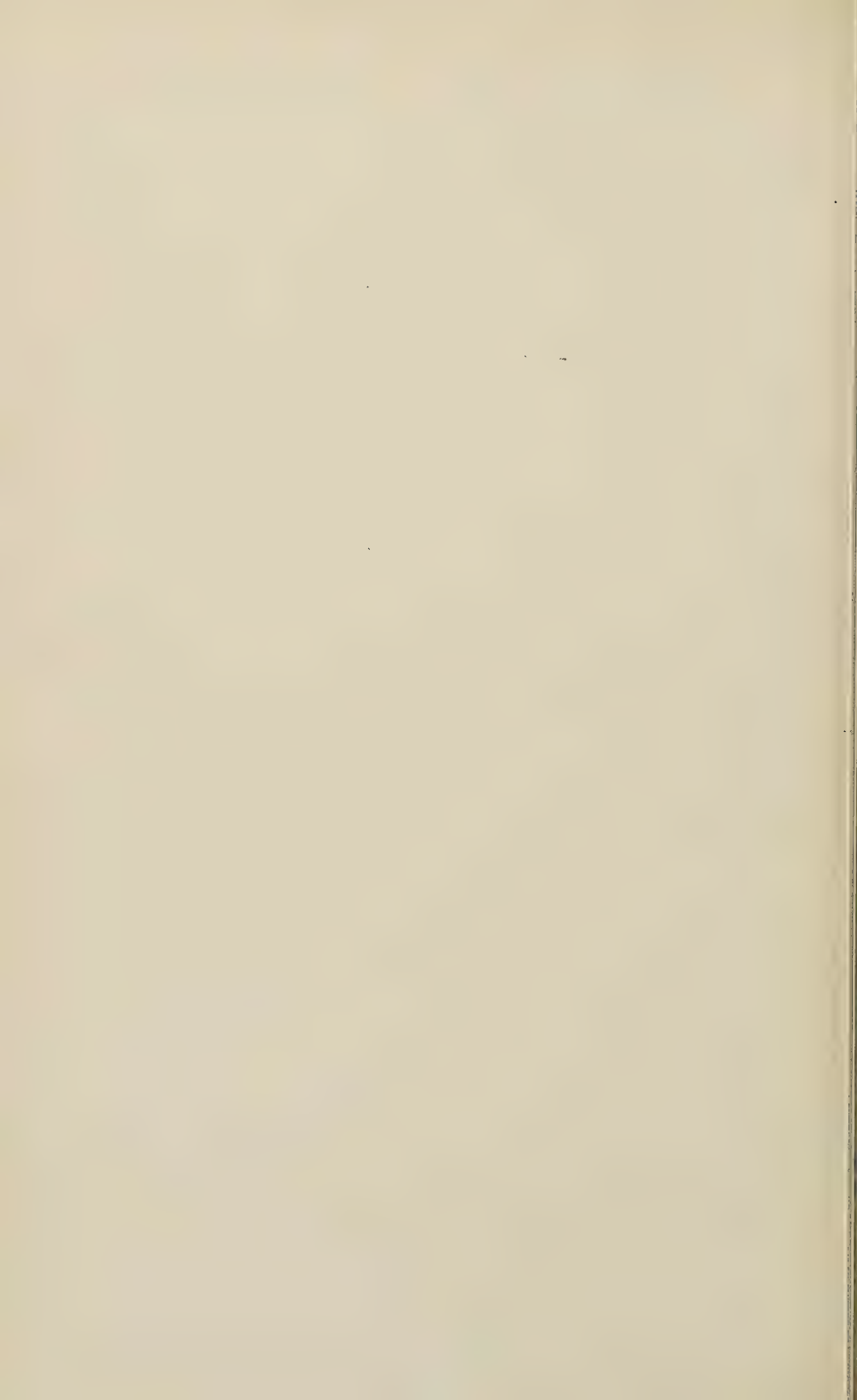
FOR EXPLANATION OF PLATE SEE PAGE 160.





MEXICAN UROCOPTID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 160.



# A REVIEW OF THE FLOUNDERS AND SOLES OF JAPAN.

By DAVID STARR JORDAN and EDWIN CHAPIN STARKS,  
*Of Stanford University, California.*

In this paper is given a descriptive catalogue of the species of the families Pleuronectidæ and Soleidæ, flounders and soles, known to inhabit the waters of Japan and the shores of the Japan Sea. It is based primarily on the collection made by Professors Jordan and Snyder in the summer of 1900. Series of these specimens are in the United States National Museum, in the British Museum, and in the museum of Stanford University. The new illustrative figures are the work of Mrs. Chloe Leslie Starks and Mr. William S. Atkinson.

The flounders and soles together constitute the suborder Heterosomata. The relations of this group are uncertain, but it is evident that these fishes have no special affinity with the Gadidæ or with other forms with jugular ventral fins. Boulenger associates the flounders with the Zeidæ, and suggests the derivation of both groups from the extinct family Amphistiidæ. But there is no positive warrant for this ingenious guess.

## Suborder HETEROSOMATA.

### FLATFISHES.

Cranium posteriorly normal; anteriorly with twisted vertex, to allow two orbits on the same side of the head; basis cranii not quite simple; dorsal fin long, of jointed rays; superior pharyngeals 4, the third longest, much extended forward, the inferior separate; ventral fins thoracic rarely wanting; of more than five rays, all articulate; no fin-spines; shoulder-girdle normal, the hypercoracoid perforate. In the very young fishes the two sides of the body are alike and the eyes are one on each side, with normal cranium.

#### KEY TO FAMILIES OF HETEROSOMATA.

- a.* Preopercular margin more or less distinct, not hidden by the skin and scales of the head; eyes large, well separated; mouth moderate or large; teeth present.  
PLEURONECTIDÆ, I
- aa.* Preopercular margin adnate, hidden by the skin and scales of the head; eyes small, close together; mouth very small, much twisted; teeth rudimentary or wanting.  
SOLEIDÆ, II



## Family I. PLEURONECTIDÆ.

FLOUNDERS: HIRAME OR KAREI in Japanese.

Body strongly compressed, oval or elliptical in outline; head unsymmetrical, the cranium twisted, both eyes being on the same side of the body, which is horizontal in life, the eyed side being uppermost and colored, the blind side lowermost and usually plain. In the very young fish the bones of the head are symmetrical, one eye on each side, and the body is vertical in the water. In most species the cranium becomes twisted, bringing the upper eye over with it. Eyes large, well separated; mouth small or large, the dentition various, the teeth always present; premaxillaries protractile; no supplemental maxillary bone; pseudo-branchiæ present; gills 4, a slit behind the fourth; lower pharyngeals separate; no air-bladder; preopercle with its margin usually distinct; not wholly adnate or hidden by the skin of the head; vent not far behind head, the viscera confined to the anterior part of the body; scales various, rarely absent, usually small; lateral lines usually present, extending on the caudal fin, sometimes duplicated or wanting. Dorsal fin long, continuous, of soft rays only, beginning on the head; anal similar, shorter; caudal various, sometimes coalescent with dorsal and anal; pectorals inserted rather high, rarely wanting; ventrals thoracic under the pectorals, usually of several soft rays, one of them sometimes wanting. Fishes mostly carnivorous, inhabiting sandy bottoms in all seas, some species ascending rivers.

Most of the flounders are valued as food, the flesh being white and wholesome, but rather tasteless, and in some species somewhat coarse. These fishes are known in Japanese as Karei, usually with an adjective prefix, indicating the different species, as Kurokarei, black flounder; Mizugarei, water flounder; Ishigarei, rock flounder. The larger ones are called Hirame or halibut (*hira*, broad; *me*, eye).

Apparently the members of the Psettinae or Turbot tribe are more primitive than the other subfamilies represented in Japan. The relative simplicity of structure in the Halibut tribe is of the nature of degeneration.

The earliest fossil flounders, from the European Cretaceous, are related to the genus *Bothus*, which contains the Brill, *Bothus rhombus*, an ally of the Japanese genus, *Platophrys*.

## KEY TO SUBFAMILIES OF PLEURONECTIDÆ.

- A. Ventral fins unsymmetrical, dissimilar in position and usually also in form, the ventral fin of the eyed side being extended along the ridge of the abdomen. Eyes and color on the left side. (Turbot tribe).....PSETTINÆ, I
- AA. Ventral fins symmetrical, similar in position and in form of base, the ventral of the colored side not extended along the ridge of the abdomen.
  - a. Mouth nearly symmetrical, the dentition nearly equally developed on both

sides, the gape usually, but not always wide. Eyes and color on the right side in most northern forms, on the left side in others. (Halibut tribe.)

HIPPOGLOSSINÆ, II

aa. Mouth unsymmetrical, the jaws on the eyed side with nearly straight outline, the bones on the blind side strongly curved; teeth chiefly on the blind side.

b. Eyes and color on the right side (with occasional exceptions). (Plaice tribe).....PLEURONECTINÆ, III

## I. Subfamily PSETTINÆ.

### TURBOT TRIBE.

*Large-mouthed flounders, with the ventral fins unsymmetrical.*—Mouth symmetrical, the dentition nearly equally developed on both sides; gape usually wide (narrow in *Platophrys*, *Etropus*, etc.), the maxillary commonly more than  $\frac{1}{3}$  length of head; lower pharyngeals narrow, each with one or more rows or a narrow band of small, sharp teeth; teeth in jaws acute; eyes not minute; pectorals and ventrals usually well developed; edge of preopercle free; ventral fins dissimilar in form or in position, that of the left or eyed side inserted on the ridge of the abdomen, its base extended along this ridge, its rays more or less wide apart; caudal fin rounded or subtruncate; no accessory lateral line; anal spine usually weak or obsolete; a pelvic spine sometimes developed; vertebræ in moderate or small number, 31 to 45. Body sinistral. Species chiefly tropical or subtropical in distribution, scantily represented in Japan.

The Turbots are here placed at the beginning of the flounder series as the most primitive of flounders, though not the most simple in anatomical structure.

### KEY TO GENERA.

- a. Pectoral fin of both sides present; septum of gill-cavity below gill-arches without foramen; a deep emargination near the isthmus; ventral fins free from anal.
- b. Vomer toothless; ventral fins free from anal; caudal fin subsessile.
- c. Lateral line with a distinct arch in front; teeth small, uniserial, or biserial.
- d. Interorbital space more or less broad, deeply concave, at least in the males; form broad ovate; gillrakers short and thick.
- e. Scales small, ctenoid, adherent, 75 to 100 or more; teeth mostly uniserial; anterior rays of dorsal not elevated; pectoral of left side usually filamentous in the male; vertebræ (in *P. lunatus*) 9+30=39. . . . .*Platophrys*, 1
- ee. Scales large, deciduous; anterior dorsal rays not elevated. . . . .*Scæops*, 2
- dd. Interorbital space narrow, sometimes reduced to a simple ridge; dorsal not elevated in front; scales large, firm; gillrakers slender; teeth in two series. . . . .*Engyprosopon*, 3

## II. Subfamily HIPPOGLOSSINÆ.

### HALIBUT TRIBE.

*Large-mouthed flounders, with the ventral fins symmetrical.*—Mouth symmetrical, the jaws and the dentition nearly equally developed on both sides; gape usually wide, the maxillary more than  $\frac{1}{3}$  length of head; lower pharyngeals narrow, usually with but 1 or 2 rows of sharp

teeth; teeth in jaws usually acute; eyes large; edge of preopercle free; pectoral and ventral fins well developed, *the ventral fins similar in position* and in form of base, the ventral fin of the eyed side not being attached along the ridge of the abdomen. Septum of gill cavity without foramen.

The existing species are mostly arctic or subarctic, and mostly dextral, but the more primitive forms (allied to *Paralichthys*) are largely semitropical and sinistral.

## KEY TO GENERA.

- a. Vertebrae and fin rays in moderate numbers (vertebrae fewer than 46, dorsal rays fewer than 95, anal rays fewer than 75); caudal fin not concave, the middle rays longest.
  - b. Dorsal fin beginning in advance of eye; teeth sharp, uniserial; eyes sinistral (rarely reversed); lateral line with a strong arch in front; no anal spine. Species tropical or semitropical, allied to *Paralichthys*.
  - c. Scales moderately ctenoid; gillrakers slender; some of the teeth canine-like; none of the rays much produced; vertebrae 30 to 40.
  - d. Lateral line with a short accessory branch extending from near the opercular angle to base of dorsal fin; body rather deep. .... *Pseudorhombus*, 4
  - dd. Lateral line without accessory branch; body more elongate; mouth large. *Paralichthys*, 5
  - bb. Dorsal fin beginning above the pupil.
    - e. Lateral line with short more or less semicircular arch in front; vertebrae 35 to 41; anal spine present or absent; body normally sinistral; scales ctenoid; teeth rather small (genera allied to *Verasper*, in the temperate Pacific).
    - f. Anal spine weak or obsolete; teeth in two series.
      - g. Gillrakers long and slender ..... *Xystrias*, 6
      - gg. Gillrakers short and broad ..... *Verasper*, 7
      - ff. Anal spine strong; teeth uniserial; interorbital area scaly. .... *Acanthopsetta*, 8
    - ee. Lateral line without distinct arch in front; vertebrae 40 to 46; body normally dextral; scales ctenoid; anal spine usually present. Species of subarctic distribution, allied to *Hippoglossoides*.
    - h. Lateral line simple, without accessory branch; teeth sharp, uniserial below.
      - i. Upper eye lateral; no bony or warty plates.
        - j. Jaws with distinct canines; lateral line descending in a long curve. *Cynopsetta*, 9
        - jj. Jaws with subequal teeth; lateral line nearly straight.
          - x. Scales small, chiefly ctenoid; flesh firm; gillrakers rather few, 10 to 15 below angle; teeth uniserial in both jaws; vertebrae 45. *Hippoglossoides*, 10
          - xx. Scales mostly cycloid; flesh feeble; gillrakers rather numerous, about 25 below angle. .... *Cleisthenes*, 11
      - ii. Upper eye nearly vertical, on the middle line of upper outline of body, as in *Atheresthes*, the dorsal beginning behind it; head with warty plates. .... *Protopsetta*, 12
  - aa. Vertebrae and fin rays much increased in number (the vertebrae about 50; dorsal rays about 100, anal rays about 85); body comparatively elongate; caudal fin lunate; lateral line simple; and spine mostly obsolete. Dextral species, arctic in distribution. (Genera allied to *Hippoglossus*.)
    - y. Large teeth not arrow-shaped, biserial above, uniserial below; scales very small, cycloid; gillrakers long and slender; eyes strictly lateral.

- z. Lateral line with an anterior arch; lower pharyngeal teeth biserial; vertebræ (in *H. hippoglossus*)  $16 + 34 = 50$ .....*Hippoglossus*, 13  
zz. Lateral line nearly straight; lower pharyngeal teeth in one row. ....*Reinhardtius*, 14  
yy. Large teeth in both jaws arrow-shaped, biserial, some of them depressible; upper eye with vertical range; gillrakers short; scales deciduous, ciliated; lateral line without arch; flesh soft. Vertebræ  $12 + 37 = 49$ ...*Atheresthes*, 15

### III. Subfamily PLEURONECTINÆ.

#### PLAICE TRIBE.

Mouth small, unsymmetrical, the jaws on the eyed side with nearly straight outline, the bones on the blind side strongly curved; dentition chiefly developed on the blind side; eyes large; edge of preopercle not hidden by the scales; pectoral fins well developed; vertical fins well separated; ventral fins nearly or quite symmetrical, that of the eyed side not prolonged along the ridge of the abdomen; anal spine usually strong (obsolete in *Microstomus* and *Veræqua*). Body dextral (except frequently in *Platichthys stellatus*). Species arctic or subarctic in distribution.

#### KEY TO GENERA.

- a. Vertebræ in moderate number (36 to 44); dorsal rays 65 to 80; anal rays 45 to 60.  
b. Teeth in bands, small, acute; lower pharyngeals narrow, with small teeth, usually two-rowed.  
c. Lateral line without branch, and with a broad arch in front; scales large, ctenoid, caducous; gillrakers short and sharp .....*Alxops*, 16  
cc. Lateral line with an accessory dorsal branch, without arch in front; lips thick, folded; dorsal fin beginning on blind side .....*Pleuronichthys*, 17  
bb. Teeth in a single row, usually bluntish or incisor-like.  
d. Lateral line with an accessory dorsal branch, and with a distinct arch in front; scales imbricated, firm, rough-ctenoid .....*Lepidopsetta*, 18  
dd. Lateral line without accessory branch.  
e. Lateral line with a semicircular arch in front.  
f. Body robust; anal spine present; scales usually but not always ctenoid .....*Limanda*, 19  
ff. Body slender and fragile; scales very small, cycloid; no anal spine .....*Veræqua*, 20  
ee. Lateral line without arch in front.  
h. Scales present.  
i. Bases of vertical fins without stellate tubercles.  
j. Scales regularly imbricate, all on eyed side, ctenoid in both sexes.  
k. Scales large (60 to 65), loose, with slender spinules; interorbital space narrow, naked; teeth not close-set.  
l. Eyeball scaly above .....*Dexistes*, 21  
ll. Eyeball scaleless .....*Araïas*, 22  
jj. Scales imperfectly imbricated or else not ctenoid; teeth blunt, close-set.  
m. Scales chiefly cycloid in both sexes; lower pharyngeals each with one row of small teeth .....*Pleuronectes*, 23  
mm. Scales rough-ctenoid in the male, mostly cycloid in the female; lower pharyngeals large, with 5 or 6 rows of large blunt, close-set teeth .....*Liopsetta*, 24



- ii. Bases of fin rays with rough tubercles; scales rough, stellate, scattered, mostly not imbricated; head with stellate tubercles; lateral line scaleless; lower pharyngeals broad, each with three rows of blunt teeth; teeth in jaws incisor-like.....*Platichthys*, 25
- hh. Scales none; body naked or with rough warts or tubercles.
  - n. Body naked in youth, the adult with irregular rows of horny elevations, two or three on the eyed side; blind side naked.....*Kareius*, 26
  - nn. Body naked in youth, the adult with many rows of warty tubercles, some of them regularly arranged, these on the eyed side; blind side naked.....*Clidoderma*, 27
- aa. Vertebrae in increased number (48 to 65); dorsal rays 90 to 120; anal rays 70 to 100; teeth broad, incisor-like; lateral line simple, straight; scales small all cycloid; body elongate.
  - m. Anal spine obsolete; skull with few mucous cavities.....*Microstomus*, 28
  - mm. Anal spine present; skull with large mucous cavities.....*Glyptocephalus*, 29

### 1. PLATOPHRYS Swainson.

*Solea* RAFINESQUE, Indice di Ittiologia Siciliana, 1810, p. 52 (*rhomboide*); not of QUENSEL, 1806.

*Platophrys* SWAINSON, Nat. Hist. Class'n Fishes, II, 1839, p. 302 (*ocellatus*).

*Peloria* COCCO, Intorno ad Alcuni Pesci del mar di Messina, Giorn. del Gabin., 1844, pp. 21-30, Lettere di Messina (*heckeli*, a larval form of *P. podas*); not *Pelorus* of MONTFORT, 1808.

? *Coccolus* BONAPARTE, in COCCO, Alcuni Pesci Messina, 1844, p. 21 (*annectens*; larval form—probably of *P. podas*, with the right eye in transit to the left side).

*Bothus* BONAPARTE, Catalogo Metodico, 1846, p. 49 (*podas*); not of RAFINESQUE. *Rhomboidichthys* BLEEKER, Act. Soc. Sci. Indo-Nederl. Manad. and Makassar, 1857-58, p. 67 (*myriaster*).

*Platophrys* BLEEKER, Comptes Rendus Acad. Sci. Amsterd., XIII, 1862, Pleuron., 5 (*ocellatus*).

Eyes and color on the left side. Body ovate, strongly compressed; mouth of the large type, but comparatively small; the maxillary  $\frac{1}{3}$  or less of the length of the head; teeth small, subequal, in 1 or 2 series; no teeth on vomer or palatines. Interorbital space broad and concave, broadest in adult males. Gillrakers moderate. Dorsal fin beginning in front of eye, all its rays simple; ventral of colored side on ridge of abdomen; caudal convex behind; pectoral of left side usually with one or more filamentous rays, longest in the male. Scales very small, ctenoid, adherent; lateral line with a strong arch in front. Coloration usually variegated.

This well-marked genus is widely diffused in the warm seas. The sexual differences are greater than usual among flounders, and the different sexes have often been taken for different species. As a rule, in the males, the pectoral fin on the left side is much prolonged, the interorbital area is much widened and very concave, and there are some tubercles about the snout and lower eye. The young fishes, as is usually the case, resemble the adult females.

The very young are translucent, with the eyes symmetrical. The species of *Platophrys* are widely distributed through the warm seas, no



tropical waters being wholly without them. All the species of *Platophrys* are extremely closely related, and can be distinguished with difficulty. On the other hand, the variations due to differences of age and sex are greater than in any other of our genera.

(*πλατύς*, broad; *ὄφρὺς*, eyebrow.)

# 1. PLATOPHRYS MYRIASTER (Temminck and Schlegel).

*Rhombus myriaster* TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 181, pl. xcii, fig. 2 (Nagasaki).

*Rhomboidichthys myriaster* BLEEKER, Act. Soc. Ind. Nederl., I. Manado and Macassar, p. 67 (Celebes); Atlas, Pleuron., pl. ix, fig. 4 (Celebes).—GÜNTHER, Cat., IV, 1864, p. 436 (Celebes; China).—ISHIKAWA and MATSU'URA, Prel. Cat., 1897, p. 25 (Kagoshima).

*Platophrys myriaster* JORDAN and SNYDER, Check-List Fish, Japan, 1901, p. 122.—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 365 (Keerun, Formosa).

*Habitat*.—Southern Japan, southward to China, Formosa, and the East Indies; north to the island of Kiusiu.

Head,  $4\frac{1}{8}$  in length to base of caudal; depth,  $1\frac{3}{4}$ ; upper eye,  $3\frac{1}{5}$  in head; maxillary,  $3\frac{3}{4}$ ; snout,  $4\frac{1}{4}$ ; interorbital space, 3; dorsal, 94; anal, 71; scales, 104.

Body rather broad; the anterior upper outline a short, even curve, becoming nearly vertical in front of eyes; snout somewhat projecting, its upper outline not continuous with that of head; mouth arched; each jaw with a row of sharp, slender, recurved teeth, outside of which toward front is another row of more irregular stouter but shorter teeth; maxillary reaching very slightly past anterior rim of lower orbit; interorbital broad and concave, rising on each side to a high, smooth orbital rim; middle of upper eye over posterior edge of lower eye; a slight projection near tip of snout on blind side; gillrakers very short and blunt, 6 developed on lower limb of arch, only very small tubercles above.

Origin of dorsal just above snout, a little below the level of super-orbital rim of lower eye; longest dorsal rays equal to those of anal; their length,  $2\frac{1}{2}$  in head; pectoral long and very slender; its length,  $1\frac{1}{10}$  in head; caudal double truncate; arch of lateral line small, its length twice as great as its height, and contained 6 times in straight part of lateral line or two times in head. Scales very small and everywhere cycloid except a definite area at base of dorsal and anal fins, which is roughly ctenoid; at about middle of fins this area is 3 or 4 scales deep, but it tapers at each end and disappears. Scales on opercles, cheeks, posterior half of interorbital space and top of head to front of upper eye; front of head, snout, and mandible naked.

Color, rather light brown, everywhere on head and body with small brown spots ringed with light brown, lighter than ground-color, and light-blue spots ringed with dark brown; an irregular, blended, dark-

brown blotch just behind arch of lateral line and another at middle of straight portion of lateral line; dorsal and anal inconspicuously and irregularly dotted with brown dots, and at regular intervals, about 10 rays apart is a round spot, dark, nearly as large as pupil, at base of rays; 1 or 2 very faint bars on pectoral; caudal dark at base and tip of rays, a broad light band across its middle.

The above description is drawn from a female example 16 cm. in length from Keerun, Formosa. We did not find the species in Japan, although originally described from Nagasaki.

(*μυρίος*, myriad; *ἀστήρ*, star.)

## 2. SCÆOPS Jordan and Starks.

*Scæops* JORDAN and STARKS, Bull. U. S. Fish. Comm., XXII, 1902 (1904), p. 627 (*grandisquama*).

This genus is near *Platophrys*, differing in the large, caducous scales; the fin rays are not produced in the male and the sexual differences are less pronounced than in *Platophrys*. Teeth one-rowed; gill-rakers very short. Size small. A second species, *Scæops pæcilura* (Bleeker), very similar to the type of the genus, occurs in the East Indies. *Scæops xenandria* is found in Hawaii.

(*σκαίος*, left; *ὤψ*, eye.)

### KEY TO SPECIES.

- a. Scales large, 36 in a lateral series. Color plain brownish; caudal fin with a black spot above and one below ..... *grandisquama*, 2
- aa. Scales smaller, 45 in a lateral series; upper eye more posterior. Color light brown, freckled with darker brown; caudal fin with three dark cross-shades. *kobensis*, 3

## 2. SCÆOPS GRANDISQUAMA (Schlegel).

DARUMAGAREI (DARUMA α-FLOUNDER): MARUTAGAREI (LOG-FLOUNDER).

*Rhombus grandisquama* SCHLEGEL, Fauna Japonica, Poiss., p. 183, 1846, pl. xcii, figs. 3, 4 (Nagasaki).

*Rhomboidichthys grandisquama* GÜNTHER, Cat., IV, p. 437 (China, also by error ascribed to the Gulf of Fonseca).—ISHIKAWA, Prel. Cat., 1897, p. 25 (Kishin).—NAMIYE, Class. Cat., 1881, p. 110 (Kishin).

*Engyprosopon grandisquama* JORDAN and SNYDER, Fish Japan, Annot. Zool. Jap. Check-List, 190, p. 122 (Nagasaki).

*Scæops grandisquama* JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1904, p. 627, pl. viii, fig. 2 (Owari Bay, Sagami Bay).

*Habitat*.—Sandy coasts of Japan, northward to Misaki.

Head,  $4\frac{1}{8}$  in length to base of caudal; depth,  $1\frac{1}{2}$ ; upper eye,  $3\frac{1}{4}$  in head; maxillary,  $3\frac{1}{4}$ ; snout,  $4\frac{3}{4}$ ; dorsal, 79; anal, 60; series of scales, 36.

Body rather broad; the anterior upper profile steep; snout a little projecting with a shallow notch above; maxillary reaching past front

<sup>a</sup> *Daruma*, a squat image of Buddha, a name also applied to certain Scorpaenoid and cottoid fishes. *Karei*, *garei* for euphony, flounder.

of lower eye, nearly to anterior margin of pupil; interorbital space of male,  $2\frac{1}{2}$  in head; of female, 4 in head (much narrower in small individuals). Male with a sharp spine on colored side of snout near tip, projecting outward and forward; another on anterior upper margin

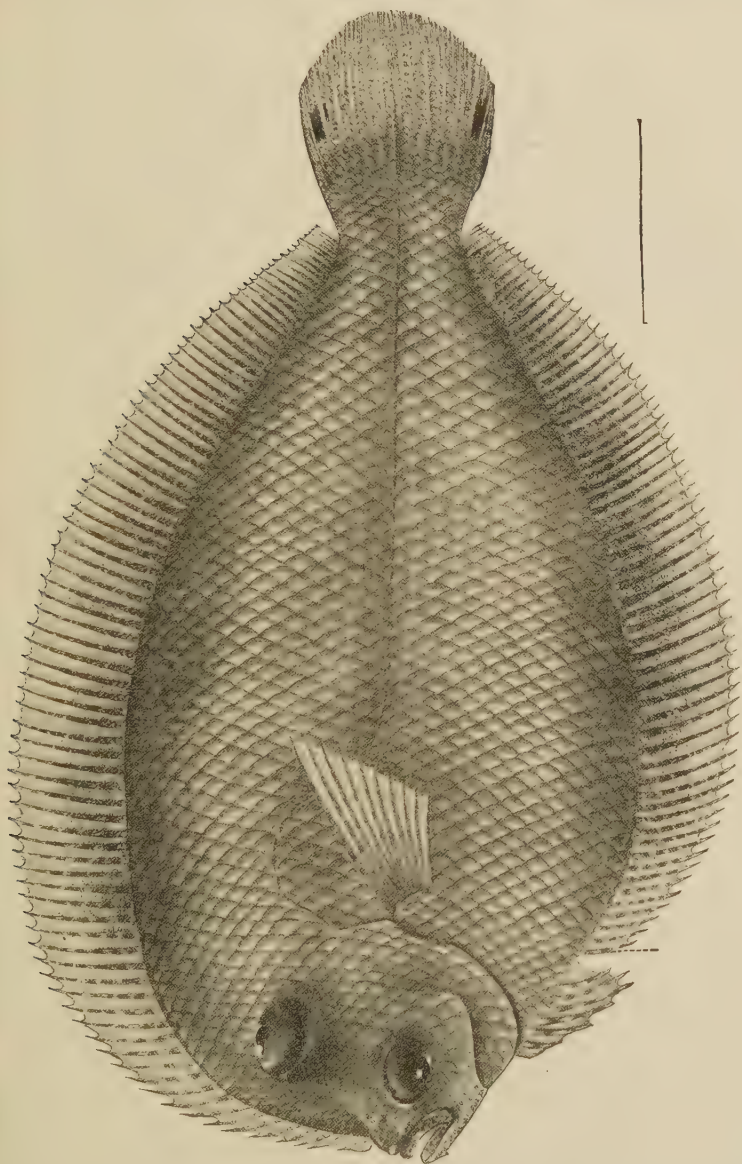


FIG. 1.—SCOPIS GRANDISQUAMA.

of lower eye, and a few rough serrations behind it; lower margin of upper eye serrated, the serræ coarser anteriorly, these serrations and spines all absent in the female. A very slight projection on snout,

but no spine as in the male; the orbital rims raised but smooth. Six short gillrakers developed on lower limb of arch, none on upper.

Origin of dorsal on blind side opposite upper rim of lower eye; pectoral of colored side long, narrow, and pointed, its length equal to that of head; pectoral of blind side blunt and only half as long as its mate; arch of lateral line,  $3\frac{1}{2}$  in straight part,  $1\frac{1}{2}$  in head.

Color rather light, mottled with dark brown, lighter than in *S. kobensis*; the fins all with small dark spots on the rays; a conspicuous black spot nearly as large as pupil on the upper and lower edges of the caudal at about the middle of the length of the rays.

Specimens were collected at Wakanoura and Nagasaki. The above description is of specimens 11 or 12 centimeters long.

The specimen here drawn is of a male with a wide interorbital space. Females of the same size as our type of *S. kobensis* have the interorbital space no wider than in that species.

(*grandis*, large; *squama*, scale.)

### 3. *SCÆOPS KOBENSIS* Jordan and Starks, new species.

Head, 4 in length to base of caudal; depth,  $1\frac{5}{8}$ ; eye, 4 in head; snout,  $4\frac{3}{4}$ ; maxillary,  $3\frac{1}{2}$ ; dorsal, 80; anal, 63; pores, in lateral line 56; 45 series of scales.

Shape of body as in *Scæops grandisquama*; the snout slightly produced; a slightly sharper notch above its tip; mouth very oblique, the maxillary reaching to front of lower eye; teeth small and rather sharp, in a single even row on jaws; middle of upper eye a little behind posterior edge of lower eye; interorbital space rather deeply concave, its width equal to vertical diameter of upper eye; no tubercles about eyes, a slight prominence at tip of snout; gillrakers very short and rather blunt, 7 developed on lower limb of arch, none on upper.

Origin of dorsal at notch above snout opposite front of lower eye; height of longest dorsal rays near middle of fin, 2 in head, equal to those of anal; pectoral of eyed side long, narrow, and pointed; its length equal to that of head; pectoral of blind side short and rather blunt, its length  $2\frac{1}{2}$  in head; ventral of eyed side 6-rayed, extending farther forward but not so far back as that of blind side, its rays much wider apart; length of arch of lateral line  $3\frac{1}{2}$  in straight part, contained  $1\frac{3}{4}$  times in head; height of arch equal to width of interorbital space; scales of eyed side everywhere finely ctenoid; the spinules long, slender, and very numerous, easily broken off, leaving the scale nearly smooth; scales of blind side cycloid; head with scales everywhere except on tip of snout, mandible and maxillary; interorbital closely scaled.

Color light grayish brown, everywhere mottled with irregular spots of very dark brown; the colors not much shaded into each other and in sharp contrast; dorsal, anal, and ventral with fine spots of dark



brown on the rays; not involving the membrane; caudal with three indistinct dark cross-bands; pectoral with fine, inconspicuous, dusky spots; a dark spot on base of rays.

This species may be known from *Scæops grandisquama* by the smaller scales and more posterior upper eye.

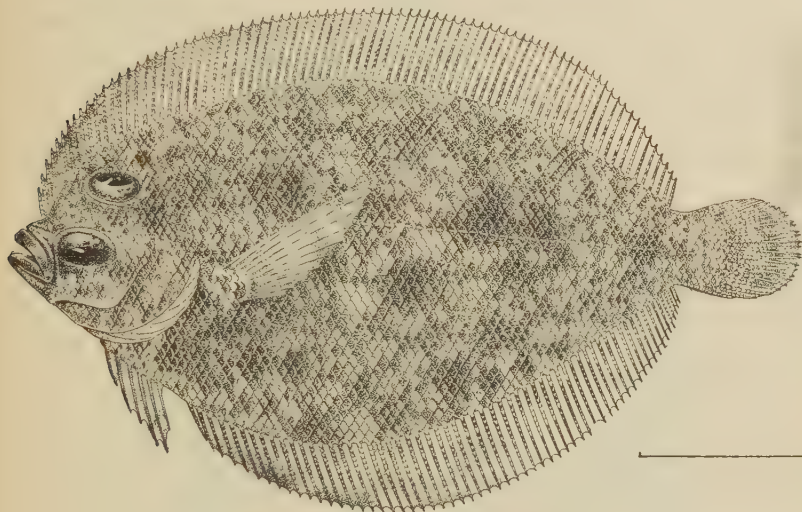


FIG. 2.—SCÆOPS KOBENSIS.

*Type*.—The only specimen was collected at Kobe. It is 83 mm. in length and is numbered 9822, Stanford University.

### 3. ENGYPROSOPON Günther.

*Engyprosopon* GÜNTHER, Cat. Fish, IV, 1864, p. 431 (*mogkii*).

Body elliptical, covered with rather large, firm scales; teeth two-rowed; gillrakers long and slender; interorbital space narrow; fin rays not produced in either sex. Sexes similar. Small sand-colored flounders of the Pacific, allied to *Arnoglossus*, but less fragile in habit, and with the teeth biserial, not sharp and uniserial as in *Arnoglossus*. The interorbital space, though narrow, is broader than in *Arnoglossus*, and in some species somewhat concave.

(ἐγγύς, contracted; πρόσωπον, forehead.)

### 4. ENGYPROSOPON IIJIMÆ Jordan and Starks.

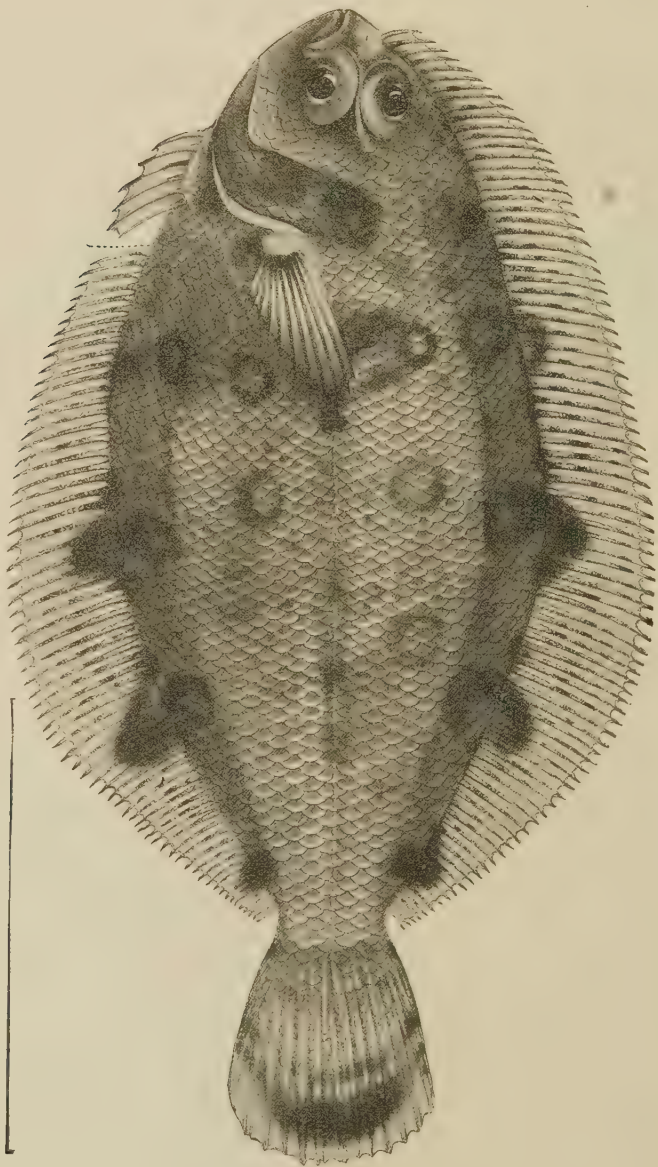
*Engyprosopon iijimæ* JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1904, p. 626, pl. VIII, fig. 1 (Suruga Bay, Japan).

Head, 4 in length; depth, 2.33 to 2.5; D. 80 to 89; A. 69 to 72; scales, 50 to 53; eye, 3 in head; maxillary, 3.5; pectoral of eyed side, 1.2; of blind side, 3; ventral, 2.25; caudal, equal to head. Anterior profile evenly curved, the orbits not reaching to its edge; eyes separated by a narrow sharp ridge, the lower the more anterior; mouth



small, the maxillary very much curved and reaching to a little past front of orbit; teeth small and set in a single row; six very short gill-rakers on lower arch of first gill. Scales finely ctenoid, the spinules on the scales slender and very numerous; blind side with cycloid

FIG. 3.—*ENGYPHOSOPON IJIMA*.



scales; lateral line with a very abrupt, short, high curve, its height contained 1.83 in its chord, which is half length of head, its beginning opposite the terminal third of pectoral. Dorsal beginning in advance of eye; pectoral of eyed side long and slender, of blind side less than

half as long; ventral with 6 rays, that of blind side not prolonged, its base beginning behind front of ventral of eyed side and its tip reaching farther past front of anal; caudal rounded behind, its outer edges broadly rounded, scarcely angulated.

Color light brown, spotted with dark brown, ocellated spots, 3 above and 3 below lateral line, the anterior upper spot in advance of that below; 5 spots with edges more blended along body near base of dorsal, 4 similar ones along body near base of anal, these involving base of fins; one on opercle just above gill-opening; pectoral of eyed side dark brown.

Two small specimens taken in from 45 to 60 fathoms, in Suruga Bay; the former, the type, 65 mm. in length, is numbered 51461, U.S.N.M.; the other is No. 8387, Stanford University.

The species differs somewhat from the type of *Engyprosopon*, but it is doubtless referable to the same genus.

(Named for Dr. Iijima, professor of zoology in the Imperial University of Tokyo.)

#### 4. PSEUDORHOMBUS Bleeker.

*Pseudorhombus* BLEEKER, Comptes Rendus, Amsterd., XIII, 1862, p. 5 (*polyspilos*).

*Rhombiscus* JORDAN AND SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 379 (*cinnamomeus*).

This genus is closely related to *Paralichthys*, which it replaces in the East Indian region. It differs in the presence of a short accessory branch of the lateral line, extending upward and forward from near the angle of the opercle to the dorsal fin. The body is less elongate than in *Paralichthys*, the mouth smaller, with feebler teeth, and the species are smaller in size. All belong to the fauna of southeastern Asia.

(*ψευδής*, false; *ρόμβος*, *rhombus*, flounder.)

##### KEY TO SPECIES.

- a. Scales small, 65 to 89 in lateral line series.
  - b. Scales ctenoid on blind side, as well as on eyed side; D. 80; A. 60. Scales 80; Gillrakers 8 below angle of arch; color dark; a black blotch on lateral line ..... *cinnamomeus*, 5
  - bb. Scales cycloid on blind side.
    - c. Gillrakers rather few, 8 to 11 below angle of arch.
      - d. Scales moderate, 74 to 80 in lateral line.
        - e. Pores in lateral line 79; D. 80; A. 63; depth  $1\frac{7}{8}$  in length; canines relatively numerous (22-18) ..... *misakius*, 6
        - ee. Pores 74; D. 78; A. 62; depth  $2\frac{1}{10}$ ; canines few (about 20-12) ..... *oligodon*, 7
      - dd. Scales very small, 98 in lateral line; D. 74; A. 56; depth  $2\frac{3}{4}$  in length.
        - ..... *dupliciocellatus*, 8
    - cc. Gillrakers numerous, 16 or 18 below angle of arch; D. 77; A. 52; scales 60; body with about 5 dark ocelli ..... *ocellifer*, 9
  - aa. Scales large, 40 to 50 in lateral series; D. 66; A. 48; mouth small; body with pale spots besides dark ones ..... *oligolepis*, 10

## 5. PSEUDORHOMBUS CINNAMOMEUS (Schlegel).

GANZOBIRAME (GANZO,<sup>a</sup> HALIBUT).

*Rhombus cinnamomeus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 180, pl. xciii (Nagasaki).—BLEEKER, Act. Soc. Ind. Nederl., III, Japan p. 25 (Nagasaki).

*Pseudorhombus cinnamomeus* GÜNTHER, Cat., IV, 1862, p. 427 (Nagasaki).—NAMIYE, Class. Cat., 1881, p. 110 (Tokyo).—OTAKI, Journ. Imp. Bureau Fish, Tokyo, 1897, p. 6, pl. iii, fig. 2 (S. E. Japan).—ISHIKAWA, Prel. Cat., 1897, p. 25 (Kishin, Tosa).

*Rhombiscus cinnamomeus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 379 (Tokyo); Check-List, p. 121 (Yokohama, Nagasaki).—JORDAN and SEALE, Proc. Davenport Ac. Sci., X, 1905, p. 16, (Hong Kong).

*Habitat.*—Coasts of Southern Japan and China, north to Tokyo.

Head,  $3\frac{3}{4}$  in length to base of caudal; depth,  $1\frac{9}{10}$ ; eye,  $5\frac{3}{4}$  in head; snout, 5; maxillary,  $2\frac{1}{2}$ ; dorsal, 79; anal, 61; pores in lateral line, 80.

Eyes nearly vertical or the lower very slightly more posterior; separated by a narrow, rather high, sharp, naked ridge; maxillary reaching to below posterior edge of lower eye; gape of mouth very much arched; teeth rather sharp and irregular in position and size; front of mandible truncate and subvertical; lower margin concave, and posterior end forming a conspicuous angle on lower side of head; gillrakers, short and pointed, teathed on the inner margin, the longest  $\frac{2}{3}$  of diameter of pupil, 8 or 9 developed on lower limb of arch.

Dorsal beginning on blind side opposite front of upper eye; pectoral rather slender, its base nearly horizontal, reaching a little past angle of lateral line; length of pectoral of eyed side  $1\frac{3}{4}$  in head; that of blind side  $2\frac{1}{4}$ ; ventrals rather small, that of eyed side a little nearer abdominal ridge than the other and a very little more anterior; length of ventral of eyed side contained 4 times in head; caudal double truncate, the middle rays reaching a sharp point, their length contained  $1\frac{2}{3}$  in head; height of curve of lateral line  $3\frac{1}{3}$  in head; length of curve  $1\frac{1}{3}$ ; scales everywhere ctenoid except anteriorly on blind side; posterior part of mandible and maxillary with a few rough scales, otherwise naked; snout and interorbital ridge naked.

Color of body uniform brownish with a spot at angle of lateral line, sometimes large and diffused, sometimes small and distinct; fins light and indefinitely speckled with light brown; slight traces of cross-streaks on ventral, none on pectoral.

Here describe from a specimen 23 cm. in length from Tokyo. Other specimens from Tsuruga, Wakanoura, Kobe, Onomichi, Nagasaki, Hukata, Kawatana, and Tokyo. We have also a young example from Hongkong.

This species is one of the commonest of Japanese flounders, standing in that regard next to *Paralichthys olivaceus*.

<sup>a</sup> Ganzo, a proper name, as Johnny-halibut.



It may be known from *P. misakius* and *P. ocellifer* by the ctenoid scales of the blind side; from the latter by its few gillrakers, and from the former by its more angulated head and higher and sharper interorbital ridge. Other differences appear in the description of *Pseudorhombus misakius*.

(*cinnamomeus*, cinnamon-colored.)

6. PSEUDORHOMBUS MISAKIUS Jordan and Starks, new species.

*Habitat*.—Coasts of Southern Japan.

Head,  $3\frac{4}{5}$  in length to base of caudal; depth,  $1\frac{1}{3}$ ; eye, 5 in head; maxillary,  $2\frac{1}{2}$ ; snout, 5; dorsal, 80; anal, 63; pores in lateral line, 79.

Anterior upper profile descending more abruptly than in *P. cinnamomeus*, the snout not so much produced, and the notch in front of upper eye smaller and sharper; mouth very much arched; maxillary reaching

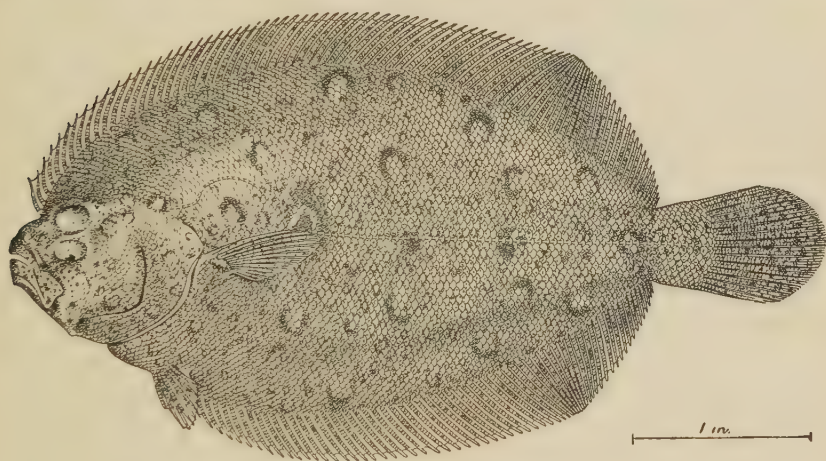


FIG. 4.—PSEUDORHOMBUS MISAKIUS. (Kobe.)

to below posterior margin of pupil; teeth smaller than in *P. cinnamomeus*, but otherwise similar; canines 17 or 18 in lower jaw, on each side, 20 to 24 on each premaxillary. Tip of mandible truncate, even with premaxillary when mouth is closed; lower edge of mandible nearly straight, slightly concave toward its tip, but not strongly concave, thus making a sharp angle below its blunt tip as in *P. cinnamomeus*; neither does its posterior end form an angle at lower outline of head; interorbital space low, not projecting above level of cheek; it is rather narrow but smoothly rounded (interorbital space a high sharp ridge in *P. cinnamomeus*); gillrakers very slightly longer than in *P. cinnamomeus* and not sharply pointed; the longest as long as diameter of pupil; 10 or 11 of them developed on lower limb of arch.

Origin of dorsal opposite notch in upper profile, or somewhat in front of anterior margin of upper eye; pectorals broadly rounded,

that of eyed side reaching two-thirds of diameter of eye past arch of lateral line, its length contained 2 times in head, its base scarcely so nearly horizontal as that of *P. cinnamomeus*; pectoral of blind side  $2\frac{2}{5}$  in head; ventrals both longer and wider than in *P. cinnamomeus*, though having the same number of rays (6); length of ventral of eyed side  $2\frac{3}{5}$  in head, its origin slightly in front of that of blind side; caudal pointed, its posterior margin double truncate; height of curve of lateral line  $4\frac{1}{5}$  in head, its length 2 (shorter than in *P. cinnamomeus*); snout and lower jaw naked; a few scales on posterior edge of maxillary; scales on eyed side everywhere strongly ctenoid, including a row on each ray of vertical fins; scales of blind side everywhere cycloid.

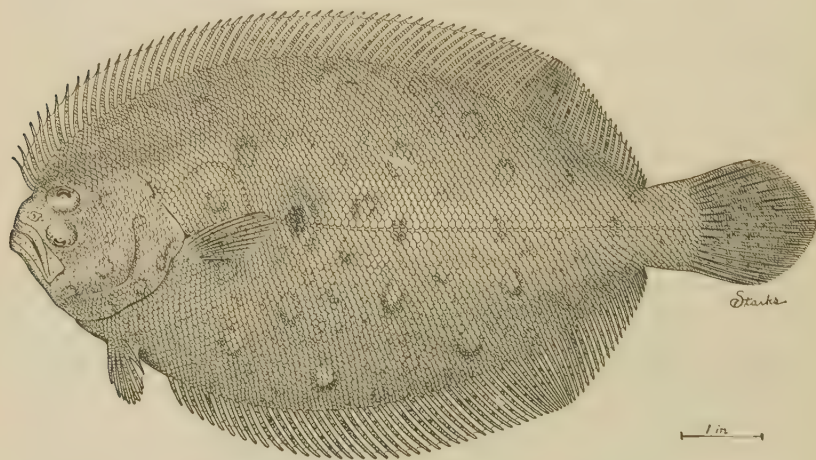


FIG. 5.—*PSEUDORHOMBUS MISAKIUS*. (Misaki.)

Color brown, indefinitely mottled with darker brown; vertical fins flecked and spotted with brown; a dark spot at tip of pectoral more or less definitely ocellated, with light brown or white.

The above description is of the type, 25 cm. in length. Other specimens vary as follows: Dorsal from 79 to 86; anal 61 to 67; pores of lateral line 79 to 85.

Of this species we have numerous specimens from Misaki, Kobe, Tsuruga, and Wakanoura. The type is from Kobe and is numbered 55643 U.S.N.M. Others are No. 9823, Stanford University.

This is one of the common Japanese flounders, but it appears thus far to have escaped notice, unless *Pseudorhombus oligodon* proves to be the same species.

(Misaki, *mi*, red; *saki*, point; one of the best known of Japanese fishing villages, the location of the marine zoological station of the Imperial University of Tokyo.)



7. *PSEUDORHOMBUS OLIGODON* (Bleeker).

*Rhombus oligodon* BLEEKER, Verh. Bat. Gen., XXVI, 1857, Nieuw, Nalez, Japan, p. 121 (Nagasaki); Natuur. Tyds. Nederl., VI, p. 419; Act Soc. Sci. Ind. Ned., V, Japan, pl. III, fig. 2.

*Pseudorhombus oligodon* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., 1902, XXV, p. 365 (Formosa); (scales of blind side ctenoid; gillrakers  $x+11$ . A. 57; scales 78).

*Habitat*.—Nagasaki to Formosa.

Head,  $3\frac{1}{2}$  in length to base of caudal; depth,  $2\frac{1}{6}$ ; eye,  $4\frac{1}{6}$  in head; snout, to edge of upper eye,  $4\frac{1}{2}$ ; maxillary,  $2\frac{1}{3}$ ; dorsal, 78; anal, 62; scales, 74.

Upper eye slightly anterior to lower; interorbital space very narrow; maxillary reaching to opposite posterior margin of lower eye or a little past; canines fewer than in related species, about 20 on each side of upper jaw; lower jaw with about 12, said to be in two rows of 6 each.

Second ray of dorsal opposite front of upper eye; pectoral bluntly pointed reaching to angle of lateral line; its length  $1\frac{3}{8}$  in head; middle rays of caudal longest, forming a slight broadly rounded angle, arch of lateral line contained  $2\frac{3}{4}$  in straight part.

Color uniform dusky on body with a dark blended blotch at angle of lateral line; pectoral without markings, other fins with small round dusky spots scattered over them.

(Here described from the plate of the type specimen published by Bleeker.)

This species we did not find in Japan. It is known to us from a specimen from Formosa.

(ὀλίγος, few; ὀδόνος, tooth.)

8. *PSEUDORHOMBUS DUPLICIOCELLATUS* Regan.

*Pseudorhombus dupliciocellatus* REGAN, Ann. Mag. Nat. Hist., 1905, p. 26 (Kobe).

*Habitat*.—Inland Sea of Japan.

Head, 4 in length; depth,  $2\frac{2}{3}$ ; eye,  $4\frac{2}{3}$  in head; dorsal, 74; anal, 56; scales, 98; transverse series above curve of lateral line, 18.

Snout a little shorter than eye; eyes separated by a ridge; maxillary extending to below middle of eye; gillrakers short and stout, 8 or 9 on lower part of arch; scales ctenoid on ocular side; cycloid on blind side; pectoral of ocular side three-fifths of head; of blind side two-fifths; middle caudal rays longest; two-ninths of length; caudal peduncle one-half as long as deep.

Color olivaceous, with darker spots and markings and with 5 conspicuous ocelli or double ocelli arranged thus ::; fins with small dark spots. Total length 380 mm. (Regan.)

This species is unknown to us.

(*duplex*, double; *ocella*, eye-spot.)

## 9. PSEUDORHOMBUS OCELLIFER Regan.

?? *Pseudorhombus pentophthalmus* GÜNTHER Cat. Fish, IV, 1862, p. 428 (China).

*Pseudorhombus pentophthalmus* GÜNTHER, Shore Fishes Challenger, 1880, p. 6<sup>c</sup>, (Inland Sea of Japan) not of Günther, 1862, according to Regan.

*Pseudorhombus russelli* OTAKI, Journ. Fish Bur., 1897, p. 6 (S. E. Japan), not *Platessa russelli* GRAY.

*Pseudorhombus ocellifer*<sup>a</sup> REGAN, Ann. Mag. Nat. Hist., 1905, p. 25, (Inland Sea of Japan), from Günther's specimens.

*Habitat*.—All coasts of southern and central Japan, north to Mororan on Volcano Bay.

Head, 3.33 in length without caudal; depth, 2; D. 71; A. 52; pores, in lateral line 68; upper eye, 5 in head; snout, 3.87; maxillary, 2; pectoral (eyed side), 1.75; blind side, 2.4; caudal, 1.33.

Body broad and thin, ventral and dorsal outlines evenly curved; snout blunt, obliquely truncate, separated from anterior profile by a notch; eyes separated by a narrow sharp ridge which is continuous backward and upward above cheek; anterior edge of eyes about even, posterior edge of upper eye a little more posterior than that of lower; mouth much curved, the maxillary reaching to posterior edge of lower eye; teeth sharp and curved, set in a single row on each jaw, some of them very slightly arrow-shaped at tips; on blind side teeth on premaxillary grow smaller backward and disappear opposite the middle of length of maxillary; gillrakers moderately slender and long, the longest slightly exceeding half diameter of eye, 6+16 to 18 in number. Dorsal beginning slightly toward blind side a little in front of anterior edge of upper eye, the first ray at notch separating the snout, anterior rays somewhat produced beyond the membrane; pectoral of eyed side longer than that of blind side; ventrals similar in size and position; caudal with the middle rays produced and with no lateral angles, the sides being broadly rounded. Scales ctenoid on eyed side, spinules short, sharp, and numerous; cycloid on blind side; scales on all fin rays rather large, even, and ctenoid on eyed side; lateral line strongly arched anteriorly, a branch from above gill opening running to dorsal profile above posterior edge of eye, opposite eighth ray of dorsal.

Color light brown, with dark spots nearly as large as eye, and sometimes indefinitely ocellated, scattered over the body, one at angle of

<sup>a</sup> Head,  $3\frac{2}{3}$  in length; depth 2 to  $2\frac{1}{2}$ ; dorsal 68 to 73; anal 53 to 57.

Snout shorter than eye, the diameter of which is  $3\frac{1}{2}$  to  $3\frac{2}{3}$  in head; eyes separated by a ridge; maxillary extending to below middle of eye or beyond; gillrakers longer than gill fringes, 17 or 18 on lower part of arch; scales ctenoid on ocular side, cycloid on blind side, 64 to 72 in a longitudinal series; 11 to 13 in a transverse series from dorsal to curve of lateral line; pectoral of ocular side two-thirds to three-fourths of length of head; of blind side one-half; caudal with the middle rays longest, 4 in length; caudal peduncle one-third to one-half as long as deep.

Color brownish with darker spots and markings, of which 5 ocelli arranged thus : : are most prominent. Fins with small dark spots. Total length 125 mm. (Regan.)

lateral line, three on back in a row following dorsal outline and a distance below base of dorsal equal to postorbital length of head, three on lower part of side similarly arranged and opposite those on back; fins irregularly speckled with brown.

According to Regan, this Japanese species is distinct from *Pseudorhombus pentophthalmus*, described by Günther, from China. It has much in common with *Pseudorhombus russelli* described from Canton by Gray. It seems to differ in color and also in the larger size of the mouth. *Pseudorhombus arsius* from the Ganges, as described by Bleeker, is different from our species, but it may be identical with *Pseudorhombus russelli*.

This species resembles *P. misakius* and *P. cinnamomeus*, but may be known by its fewer fin rays and by the more numerous gillrakers.

Our numerous specimens, none of them more than 8 inches long, are from Nagasaki (17), Kobe (17), Tokyo (6), Wakanoura (1), and Mororan (1).

(*ocellifer*, bearing eye-like spots.)

#### 10. PSEUDORHOMBUS OLIGOLEPIS Bleeker.

*Rhombus oligolepis* BLEEKER, *Vijde Bijdrag Japan*, 1869, p. 8, pl. II, fig. 2, (Nagasaki) (young example).

*Pseudorhombus oligolepis* GÜNTHER, *Cat. Fish*, IV, p. 430; copied.

*Habitat*.—Nagasaki.

Dorsal, 66; anal, 48; lateral line, 38.

Teeth in jaws conical, small subequal, more than 30 on each side of upper jaw and about 16 on the lower; height of the body two-fifths of total length; eyes very close together, the upper being scarcely in advance of the lower; lateral line with a strong curve anteriorly; scales ciliated; pectoral a little shorter than head. Olive, with brownish and pear colored spots. (Günther, after Bleeker.) Length, 64 mm.

Bleeker's plate shows the dorsal to have 69 rays, the anal 47; pores of the lateral line, 48; scales about 40; head  $3\frac{1}{2}$  in length to base of caudal; depth, 2; pectoral  $1\frac{1}{2}$  in head; maxillary reaching to below front of pupil; lateral line with a small auxiliary branch.

This species is known from a small specimen obtained by Bleeker from Nagasaki. Its very large scales should apparently entitle it to generic separation from *Pseudorhombus*. The character, however, needs verification.

(ὀλίγος, few; λεπίς, scale.)

#### 5. PARALICHTHYS Girard.

*Paralichthys* GIRARD, *U. S. Pac. R. R. Surv.*, X, 1858, p. 146 (*maculosus*=*californicus*).

*Uropsetta* GILL, *Proc. Ac. Nat. Sci. Phila.*, 1862, p. 330 (*californicus*=*maculosus*).

*Chanopsetta* GILL, *Proc. Ac. Nat. Sci. Phila.*, 1864, p. 218 (*ocellaris*=*dentatus*).

Eyes and color normally on the left side. Body oblong; mouth large, oblique; each jaw with a single row of usually slender and sharp teeth, which are more or less enlarged anteriorly; no teeth on vomer or palatines. Gillrakers slender. Scales small, weakly ctenoid or ciliated; lateral line simple, with a strong curve anteriorly and with no accessory dorsal branch. Dorsal fin beginning before the eye, its anterior rays not produced; both ventrals lateral; caudal fin double truncate, or double concave, its middle rays produced; no anal spine. Species numerous, in temperate seas. This genus, as now restricted, contains a considerable number of species, inhabiting both coasts of America and the eastern coasts of Asia.

(παράλληλος, parallel; ἰχθύς, fish.)

KEY TO SPECIES.

- a.* Dorsal rays about 72; anal rays 57; scales 120.....*olivaceus*, 11  
*aa.* Dorsal rays about 80; anal rays about 60; scales 110.....*coreanicus*, 12  
*aaa.* Dorsal rays about 69; anal rays 51; scales 110.....*percocephalus*, 13

II. PARALICHTHYS OLIVACEUS (Schlegel).

**HIRAME**<sup>a</sup> (HALIBUT), **MAKAREI** (TRUE FLOUNDER), **AObAKAREI** (GREEN-LEAF FLOUNDER).

*Hippoglossus olivaceus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 184, pl. xciv, fig. 94 (Nagasaki).

*Pseudorhombus olivaceus* GÜNTHER, Cat. Fish, IV, 1862, p. 429 (Amoy); Shore Fishes Challenger, 1880, p. 69 (Inland Sea of Japan).—NAMIYE, Class. Cat., 1881, p. 110 (Tokyo).—OTAKI, Journ. Fisheries Bureau Tokyo, 1897, p. 5, pl. v, fig. 2 (Japan).

*Chenopsetta olivacea* BLEEKER, Enum. Poiss. Connues du Japan, 1879, p. 21 (Nagasaki, Osaka, Yedo).

*Paralichthys olivaceus* STEINDACHNER, Reise Aurora, 1896, p. 217 (Kobe).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 379 (Tokyo, Hakodate); Check-List, 1901, p. 121 (Yokohama, Nagasaki).

*Chenopsetta wolffi* BLEEKER, Enum. Poiss. Connues du Japan, 1879, p. 21. (Nagasaki).

*Rhombus wolffi* BLEEKER, Japan, p. 421 (Nagasaki); Vifde Bijdrag Japan, pl. II, fig. 2 (D. 79; A. 61).

*Habitat*.—All coasts of Japan, north to Volcano Bay.

Head,  $3\frac{3}{4}$  in length to base of caudal; depth,  $2\frac{1}{2}$ ; eye,  $7\frac{1}{2}$  in head; interorbital space,  $9\frac{1}{2}$ ; snout,  $4\frac{1}{4}$ ; maxillary,  $2\frac{1}{8}$ ; dorsal, 72; anal, 57; pores of lateral line, 120.

Lower jaw truncate, nearly vertical at the tip, and strongly projecting, its posterior end forming an angle at lower outline of head; maxillary reaching to slightly past posterior margin of lower eye; gape of mouth strongly arched; teeth sharp, slender and irregular in size and position, usually covered by skin nearly to their tips, which easily slips back; snout and anterior part of maxillary naked; mandible sometimes entirely naked, usually with a small patch of scales posteriorly; interorbital space flat and rather wide, covered with fine

<sup>a</sup> *hira*, broad; *me*, eye; *hirame* becomes *birame* in composition, a matter of euphony.



scales; lower eye very slightly posterior to upper; gillrakers rather long and slender, the longest nearly as long as diameter of eye;  $6+16$  in number.

Pectorals rounded, that of eyed side reaching a little past arch of lateral line, its length 3 in head; ventral of eyed side a little nearer to abdominal ridge than that of blind side, its length equal to distance from tip of snout to middle of lower eye; origin of dorsal opposite front of upper eye; caudal double truncate.

Color brownish gray speckled with dark brown and white, the former color often arranged in rings and half rings, the white in small round spots scattered irregularly and sparsely over the body, often entirely absent, or in a single more or less definite series following the dorsal and ventral outlines; vertical fins colored like body; pectoral and ventral with irregular broken lines across the rays.

The above measurements were made from a specimen 32 cm. in length from Hakodate.

Other specimens are from Mororan, Same, Hakodate, Misaki, Aomori, Matsushima, Tokyo, Wakanoura, Kobe, Kawatana, Onomichi, Hiroshima, and Nagasaki. It is the largest as well as the most abundant of all the Japanese flounders, the halibut excepted, everywhere used as food.

(*olivaceus*, olive-colored.)

## 12. *PARALICHTHYS COREANICUS* (Schmidt).

*Paralichthys olivaceus* var. *coreanicus* SCHMIDT, Pisc. Mar. Orient, 1904, p. 230 (Gensan, Korea).

*Habitat*.—Korea, not known from Japan.

Dorsal rays, 80; anal rays, 60; scales, 110 (Schmidt); otherwise essentially as in *Paralichthys olivaceus*, from which it may not be separable.

(*Coreanicus*, Korean).

## 13. *PARALICHTHYS PERCOCEPHALUS* (Basilewsky).

*Platessa percocephala* BASILEWSKY, Bull. Soc. Nat. Moscow, 1855, p. 245 (Japan Sea, Peking).

*Pseudorhombus swinhonis* GÜNTHER, Ann. Mag. Nat. Hist., 1873, p. 379 (Chifu, China).

*Habitat*.—Japan Sea, not known, on the Japanese coast.

Head  $3\frac{3}{4}$  in length without caudal; depth  $2\frac{3}{8}$ ; dorsal 69; anal 51; lateral line 110.

Jaws nearly even in front, longer than eye, which is  $\frac{2}{3}$  of the head; cleft of mouth wide; length of maxillary  $2\frac{1}{2}$  in head and extending beyond eye; upper jaw with 3 pairs of canine teeth anteriorly; lower jaw with 8 or 10 strong teeth on each side; interorbital space rather flat, not so wide as vertical diameter of orbit; lower eye scarcely in

advance of upper; gillrakers rather wide set, lanceolate, and not quite as long as eye.

Origin of dorsal opposite front of orbit; dorsal terminating at a distance from caudal equal to three-fourths of the depth of the free portion of the tail, its longest rays at posterior one-third of fin, nearly as long as pectoral, and contained  $2\frac{1}{2}$  in head; caudal subtruncate or rounded; scales ciliated; maxillary and interorbital space scaly posteriorly; fin rays scaly.

Color brownish gray; head, body, and pectoral fins sprinkled over with brown dots. (Günther, from specimens 16 inches in length from Chifu (Chefoo), China.)

This species is not known to us.

(πέρκη, perch; κεφαλή, head.)

#### 6. XYSTRIAS Jordan and Starks.

*Xystrias* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902 (1904), p. 623 (*grigorjewi*).

Form of *Hippoglossoides*.—Eyes and color on the right side. Lateral line with a low arch in front; mouth rather large; the teeth rather small, in two rows; gillrakers long and slender; scales of eyed side finely ctenoid, those of blind side smooth. One species, a large flounder of Japan.

(ξυστήρ, a raker; from the long gillrakers.)

#### 14. XYSTRIAS GRIGORJEWI (Herzenstein).

##### MIZUKAREI (WATER FLOUNDER).

*Hippoglossus grigorjewi* HERZENSTEIN, Bull. Ac. Sci. Imp. Petersb., 1890, p. 134 (Hakodate).

*Xystrias grigorjewi* JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902 (1904), p. 624 (Suruga Bay).

*Hippoglossoides* sp. OTAKI, Journ. Fisheries Bureau, 1897, p. 2, pl. v, fig. 1 (South-eastern Japan).

*Verasper otaki* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 378 (Tokyo from Otaki's specimen); Check-List, p. 121, 1901.

Head,  $3\frac{1}{5}$  in length; depth,  $2\frac{1}{3}$ ; dorsal, 86; anal, 68; scales, 92, on blind side, 98; lower orbit, 4 in head; snout,  $5\frac{1}{2}$ ; maxillary,  $2\frac{1}{2}$ ; width of interorbital space, 6 in diameter of eye; height of longest dorsal rays,  $2\frac{2}{3}$  in head; anal rays,  $2\frac{2}{3}$ ; rays of right pectoral,  $1\frac{4}{5}$ ; ventral,  $3\frac{1}{2}$ ; pectoral, 11.

Body dextral, dorsal outline a little more convex than ventral. Mouth wide, oblique; outline of gape strongly curved; maxillary reaching a vertical from posterior edge of pupil; symphyseal knob small. Teeth of both jaws small, growing larger anteriorly, those of upper jaw in two series, the inner ones small, the outer larger and canine-like; teeth of lower jaw in a single series; gillrakers 6+17, rather

slender, length of longest 4 in maxillary; anterior nostril with a dermal flap which extends to posterior edge of second nostril; anterior margins of eyes opposite each other; interorbital space narrow, convex; lateral line arched above pectoral, the width of arch equal to length of pectoral; right side of body and head, except snout, lower jaw, and a small space near vent, covered with small, strongly ctenoid scales; left side of body with smooth scales; on both sides of body are small, elongate scales wedged in between the larger ones; rays of dorsal, anal, and caudal fins with small scales; posterior edge of maxillary with a few small scales; dorsal fin beginning over anterior edge of pupil, each ray with a small, projecting filament; anal with a naked spine at its insertion, rays with filaments; dorsal and anal ending

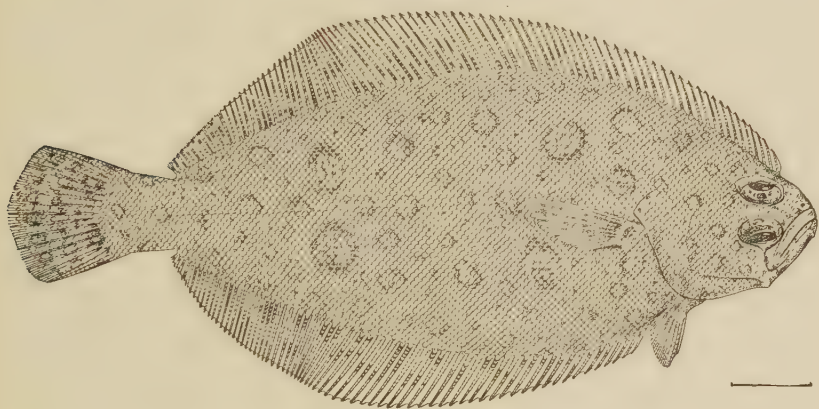


FIG. 6.—*XYSTRIS GRIGORJEWI*.

opposite each other; edge of caudal bluntly angular; upper rays of right pectoral longest; pectoral of blind side shorter, its length contained  $2\frac{1}{2}$  in head, its middle rays longest. Color in alcohol, brownish; head with an indistinct dark spot just below angle of preopercle; two similar spots on a line behind upper eye; body with 6 well-defined dark spots with indistinct light markings, arranged 3 above and 3 below lateral line; of the anterior pair, the upper is a little in advance of the lower one, others opposite each other; 2 indefinite spots above the lateral line, just posterior to angle of opercle; fins without spots; snout on blind side with a transverse black blotch, which is continued on the lower jaw.

Of this common species we have specimens from Hakodate, Matsu-shima, Aomori, and Tokyo. Mr. Masao Nakamura sends a photograph of a specimen from Uzen in Echigo.

(Named for Professor Grigorjew.)

## 7. VERASPER Jordan and Gilbert.

*Verasper* JORDAN and GILBERT, Report Fur Seal Invest., III, 1899, p. 490, (*moseri*).

Body dextral; dorsal inserted above the front of pupil; lateral line strongly arched above the root of the pectoral, without recurrent dorsal branch; scales firm, extremely spinous. Mouth large; upper teeth in 2 series, teeth uniformly small, without canines. Gillrakers short, thick, and triangular, few in number; none of the fin rays notably produced or exerted.

(*verus*, true; *asper*, rough, the word being suggested by *Veratrum*.)

## KEY TO SPECIES.

- a. Vertical fins with large, round, blended spots, not reaching to edge of fins; arch of lateral line rather low..... *variegatus*, 15  
 aa. Vertical fins, with streaks following the rays from base to tips; arch of lateral line more abrupt and higher..... *moseri*, 16

## 15. VERASPER VARIEGATUS (Schlegel).

HOSHIGAREI (STAR-FLOUNDER); ISHIAMATE (ROCK-FLOUNDER); MEDAKAKAREI (BAMBOO-FLOUNDER).

*Platessa variegata* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 176, pl. xc (Nagasaki).

*Pleuronectes variegatus* GÜNTHER, Cat. Fish., IV, 1862, p. 453 (copied); Shore Fishes Challenger, 1880, p. 69 (Yokohama).—NAMIYE, Class. Cat., p. 110, 1881 (Tokyo).—OTAKI, Journ. Fish. Bur., 1897, p. 7, pl. VII, fig. 9.—ISHIKAWA, Prel. Cat., 1897, p. 25 (Tokyo).

*Verasper variegatus* JORDAN and SNYDER, Check-List, 1901, p. 120 (Yokohama); Proc. U. S. Nat. Mus., 1901, p. 378 (Tokyo).

*Habitat*.—Southern Japan, north to Matsushima Bay.

Head,  $3\frac{1}{3}$  in length to base of caudal; depth,  $2\frac{1}{10}$ ; eye, 6 in head; maxillary, 3; snout,  $5\frac{1}{2}$ ; dorsal, 80; anal, 61; pores in lateral line, 95.

Mouth oblique, the gape strongly arched; maxillary reaching to below posterior edge of pupil; lower jaw strongly projecting; posterior end of mandible forming a slight angle at lower outline of head; teeth in two series in upper jaw, in 1 on side of lower jaw and in 2 in front; posterior margins of eyes opposite; interorbital space slightly convex, covered with rough scales; its width equal to diameter of pupil; gillrakers flat and short, 6 of them on lower limb of arch.

Arch of lateral line rather low and followed by a wavy portion, before it becomes straight posteriorly; height of curve, three-fifths diameter of eye; length of curve,  $2\frac{1}{2}$  to  $2\frac{4}{5}$  in head; scales everywhere very rough on eyed side, cycloid on blind side except an area along middle of body anteriorly, where they are rather rough by reason of a few small spinules on each scale, or in many instances a single spinule.

Dorsal beginning above front of pupil of upper eye; pectoral rounded at tip, that of eyed side, 2 in head, the other  $2\frac{1}{2}$ ; ventrals



even on both sides, 3½ in head; caudal broadly rounded, not angulated at tips of outer rays.

Body uniformly dark brown; dorsal with 6 or 7, and anal 5 or 6, large black or dark-brown spots with blended edges, the largest covering 3 or 4 rays; these nearly round near the base of the fins and not reaching the outer edge of the fin; usually 1 or 2 other spots irregularly placed opposite the interspaces and nearer edge of fin; caudal with 2 or 3 similar but smaller spots irregularly placed; blind side of body posterior to pectoral irregularly spotted with dark brown, the spots usually round, and as large, or sometimes larger than, the pupil; these present in all of our larger specimens and absent in the smaller ones up to 5 or 6 inches in length, except in one example, where they show faintly; tip of caudal of blind side edged with dusky brown.

This species may be known from *Verasper moseri* by having spots on the vertical fins rather than well-defined regular streaks—extending to the edges of the fins and by the higher, more abrupt arch of the lateral line. The blind side of *V. moseri* is sometimes irregularly spotted, but never, in our specimens, so thickly or so conspicuously. In both species the blind side is largely rusty red in life.

The spots on the fins shown in Selegue's plate\* of *Verasper variegatus* are not nearly so large as in our specimens, but they are similarly placed.

Of this common species we have specimens from Yokohama, Tokyo, Oomichi, and Matsushima. Its range is almost exclusively southerly, while *Verasper moseri* is confined to northern Japan.

(*variegatus*, varied.)

#### 16. VERASPER MOSERI Jordan and Gilbert.

*Verasper moseri* Jordan and Gilbert, Rep. Far East Exped. III 1898, p. 11188.  
(Shan Bay, Izu Islands, East Group.) Type, No. 4737. Fish. Bureau  
Capt. J. F. Moore. —International Revision, Proc. U. S. Nat. Mus. 1900,  
III, p. 2619 (Iturup).—Jordan and Snyder, Check-List, 1901, p. 121  
(Iturup, Hokkaido). Proc. U. S. Nat. Mus. 1902, p. 17. (Iturup, Hokkaido). —  
SCHMIDT, Faune Mer. Och. Jap., 1903, p. 19 (Ochotsk Sea).

*Habitat*.—Northern Japan, south to Aomori.

Head, 3½ in length to base of caudal; depth, 2; D, 22; A, 58; pectoral, 12; pores in lateral line, 84; depth of caudal peduncle 4 in greatest depth of body; length of caudal peduncle, measured axially, 1½ in its depth. Head much depressed, with rather wide, flat interorbital space, its thickness at interorbital space equalling distance between pupils of upper and lower eyes. Mouth small, very oblique, the gape strongly arched, the broad maxillary reaching a vertical behind middle of pupil, 2½ in head; mandible narrowing toward tip, with very rudimentary symphyseal knob. Teeth in upper jaw in two distinct series

throughout, those of the outer series increasing slightly in size toward front of jaw, but none of them canine-like; mandibular teeth in one row, except at symphysis, where a few teeth form a short outer series. Nasal openings of eyed side approximated in front of middle of interorbital space, the anterior with a short tube, the posterior with a raised rim. Eyes small, their anterior margins opposite, the diameter of lower eye equaling distance from tip of snout to posterior nostril,  $6\frac{1}{3}$  in head. Interorbital space rather broad and flat, not ridge-like, its total width equaling  $\frac{1}{2}$  diameter of orbit. Gillrakers short, broad, triangular, minutely toothed on inner margin, one-third diameter of eye; 7 present on horizontal limb of outer arch. Lateral line with a short high anterior arch, the cord of which is one-fifth the straight portion; height of arch one-third its length; behind the arch lateral line descending in a gentle curve to middle of sides, the scales

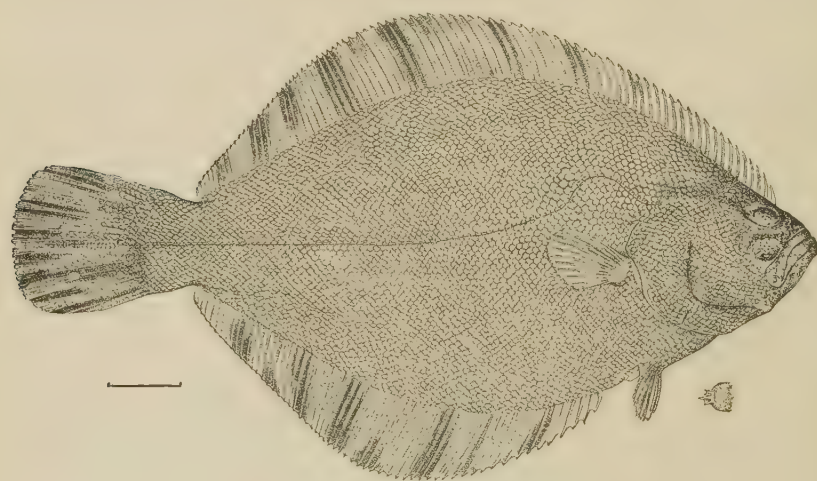


FIG. 7.—*VERASPER MOSERI*. \*

very rough, each possessing several long, sharp spines diverging from median portion of posterior margin; anterior and posterior portions of dorsal and anal fins naked, the rays of the middle portion each with a series of strongly ctenoid scales; caudal densely scaled to tip; pectorals and ventrals naked; head covered with strongly spinous scales, excepting snout, maxillary, and mandible; on blind side of head the snout, jaws, preopercle, subopercle, lower half of opercle, and all but a central strip on interopercle, scaleless; on blind side the scales are rough on head, ventral area, and along bases of ventral fins, largely smooth elsewhere. Dorsal beginning above front of pupil, the rays increasing in length to the forty-fifth, which is  $2\frac{2}{3}$  in head; longest anal ray (the seventeenth)  $2\frac{1}{4}$  in head. Caudal broadly rounded,  $1\frac{2}{3}$  in head; pectoral short and broad,  $2\frac{2}{3}$  in head; ventrals of nearly equal length, reaching origin of anal,  $3\frac{1}{5}$  in head; no anal spine. Color in

spirits, centers of the scales light gray, the margins dark brown; fins light or dusky, the vertical fins with conspicuous black bars, parallel with the rays, these most evident on under side where the pigment seems principally to occur, and are seen through the fin more faintly on the colored side; lining of cheeks and gill cover of colored side dusky; peritoneum gray.

Of this species, we have specimens from Mororan, Hakodate, Same, and Iturup Island. It is common in northern Japan, its range nowhere meeting that of *Verasper variegatus*.

(Named for Jefferson Franklin Moser, U. S. Navy, lieutenant-commander, in charge of the U. S. Bureau of Fisheries steamer *Albatross*, and a member of the United States Fur Seal Commission for 1896.)

#### 8. ACANTHOPSETTA Schmidt.

*Acanthopsetta* SCHMIDT, Faune Mer. Och., 1903, p. 19; name only (*nadeshnyi*).

This genus is allied to *Verasper*: Mouth large, teeth small, in one row; lateral line with a long low arch in front; scales moderate, ctenoid; interorbital space scaled; anal spine strong; dorsal rays about 75; anal rays about 60; caudal fin rounded. Ochotsk Sea.

(ἄκανθα, spine; ψῆττα, flounder.)

#### 17. ACANTHOPSETTA NADESHNYI Schmidt.

*Acanthopsetta nadeshnyi* SCHMIDT, Faune Mer. Ochotsk, Japan, 1903, p. 19, (Japan Sea, Vladivostok, mouth of Amur, etc.); name only; Pisc. Orient., Mar. 1904, p. 237, pl. v, fig. 1 (Vladivostok, Aneva, Askuld, Khaliz, mouth of Amur, Broughton Gulf, Paratondra, etc.)

*Habitat*.—Sea of Ochotsk.

Head,  $3\frac{1}{2}$  in length to caudal base; depth,  $2\frac{1}{4}$ ; eye,  $4\frac{3}{4}$  in head; snout to upper eye, 5; maxillary,  $2\frac{3}{5}$ ; dorsal, 74; anal, 58; pores in lateral line to base of caudal, 69.

Upper eye very slightly posterior to lower; maxillary reaching past anterior edge of eye, scarcely to pupil; interorbital space narrow and rounded, covered with small scales; its width less than half the diameter of pupil.

Origin of dorsal above middle of upper eye; longest dorsal rays  $2\frac{1}{6}$  in head; pectoral broadly rounded, its length  $1\frac{1}{5}$  in head; caudal rounded, equal in length to head; lateral line with a low arch in front contained 3 times in straight part. Uniform dusky without markings; dorsal and anal a little lighter than the body.

The species is unknown to us. It is here described from the plate published by Schmidt.

(*Nadeshnyi*, a personal name.)

## 9. CYNOPSETTA Schmidt.

*Cynopsetta* SCHMIDT, Faune Mer. Ochotsk, Jap., 1903, p. 19, name only (*dubia*).

This genus is allied to *Hippoglossoides*, differing in the presence of canine teeth, 4 in the front of the lower jaw and some above. Eyes dextral. The genus has never been defined, and in a later paper, Schmidt merges it in *Hippoglossoides*, from which it is apparently separable by its dentition and by the long low curve of the lateral line, which is however not properly arched.

(κύων, dog; ψῆττα, flounder.)

## 18. CYNOPSETTA DUBIA Schmidt.

## ABURAGARAEI (FAT-FLOUNDER).

*Cynopsetta dubia* SCHMIDT, Faune Mer. Ochotsk, Jap., 1903, p. 19 (Japan Sea, Ochotsk Sea), no description.

*Hippoglossoides dubius* SCHMIDT, Pisc. Mar. Orient, 1904, p. 227, pl. vi, fig. 1 (Mayka and Gulf of Aniva; Sea of Ochotsk).

? *Hippoglossoides* sp. OTAKI, Journ. Fish. Bur., 1897, p. 5 (S. W. coast of Japan) (D. 79 to 87; A. 58 to 64; scales 88).

*Habitat.* Ochotsk Sea, south to Northern Japan, not seen by us.

Head,  $3\frac{1}{2}$  in length to base of caudal; depth,  $2\frac{1}{2}$ ; eye,  $6\frac{1}{2}$  in head; maxillary,  $2\frac{3}{4}$ ; snout to upper eye, 5; dorsal, 87; anal, 65; scales, 88.

Eyes about opposite each other or the upper very slightly behind the lower; separated by a very narrow space which is scaled posteriorly; mouth undulating, the mandible turned up at the tip, concave behind the tip, convex at the middle, and slightly concave behind the middle; teeth rather large and unequal; maxillary reaching to posterior edge of pupil; anterior nostril ending in a tube.

Origin of dorsal opposite front of eye; longest dorsal rays equal to those of anal;  $2\frac{1}{2}$  times in head; pectoral short and rounded,  $2\frac{1}{2}$  in head; caudal broadly rounded.

Color everywhere uniform dusky without markings except a few dark, blended, very irregular spots of darker, one above middle of anal, and 4 or 5 above anterior part of lateral line.

Here described from Schmidt's plate, except for the number of scales, which is given as 88 by him. The plate shows 75 pores in the lateral line and over a hundred transverse series.

(*dubius*, doubtful.)

## 10. HIPPOGLOSSOIDES Gottsche.

*Hippoglossoides* GOTTSCHKE, Archiv fur Naturgesch., 1835, p. 164 ("*limanda*" = *platessoides*).

*Citharus* REINHARDT, Kong. Dansk. Vid. Selsk., 1838, p. 116 (*platessoides*); not *Citharus* BLEEKER, 1862.

*Drepanopsetta* GILL, Cat. Fish. East Coast N. A., 1861, p. 50 (*platessoides*).

*Pomatopsetta* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 217 ("*dentata*" = *platessoides*).



Eyes and color on the right side (except sometimes in *H. classodon*). Body oblong, moderately compressed; mouth rather large, with 1 row of sharp teeth on each jaw; no teeth on vomer or palatines; gillrakers rather long and slender; scales ctenoid; lateral line nearly straight, simple; dorsal fin low in front, beginning over or before the eye; ventrals both latter; caudal double truncate, produced behind. This genus, as here restricted, contains 3 closely related species, 2 of the North Pacific, 1 of the North Atlantic. All are essentially arctic species inhabiting shallow waters in the regions where they are most abundant.

(ἱππόγλωσσος, *Hippoglossus*; εἶδος, resemblance.)

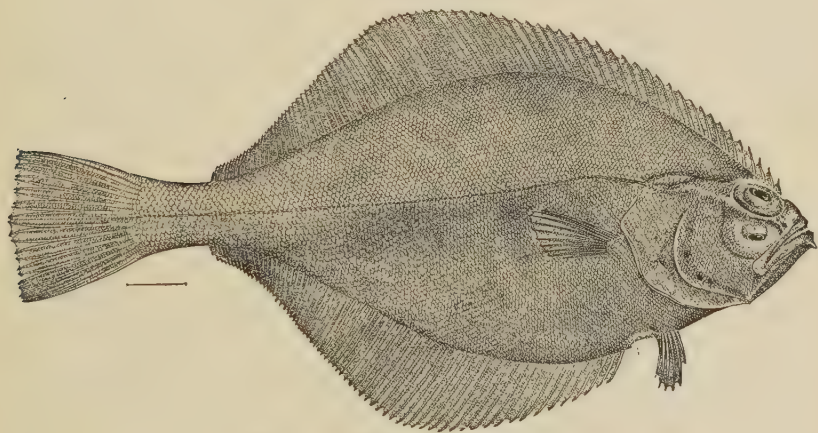


FIG. 8.—HIPPOGLOSSOIDES ELASSODON.

KEY TO SPECIES.

- a. D. 80: A 63: Scales 100: interorbital space narrow, naked.....*classodon*. 19  
aa. D. 72: A. 56: Scales 91: interorbital space with two rows of scales.  
*hamiltoni*. 20

19. HIPPOGLOSSOIDES ELASSODON Jordan and Gilbert.

*Hippoglossoides classodon* JORDAN and GILBERT, Proc. U. S. Nat. Mus., 1880, p. 278 (Seattle, Tacoma), Proc. U. S. Nat. Mus., 1880, p. 454.—BEAN, Proc. U. S. Nat. Mus., 1883, p. 20. (Alaska).—JORDAN and GILBERT, Rept. Fur Seal Invest., III, p. 1899, p. 489 (Bering Sea, Kamchatka).—JORDAN and EVERMANN, Fish North Mid. Amer., III, 1898, p. 2615, pl. CCCLXXII, fig. 920 (Seattle, Bering Sea, Kamchatka).—SCHMIDT, Pisc. Mar. Orient, 1904, p. 226 (Rimnik and Terpienia, Okhotsk Sea).

*Habitat*.—Bering Sea, Okhotsk Sea, south to Puget Sound.

Head,  $3\frac{1}{2}$ ; depth,  $2\frac{1}{2}$ ; eye, 4 in head; D. 77 to 87; A. 59 to 67; V. 6; scales, 45–100–40. Body, oblong-elliptical; caudal peduncle about as long as deep; upper profile of head continuous with the outline of back; depression over eye slight; mouth rather large, the gape curved, considerably wider on the blind side; lower jaw projecting, with a symphyseal knob; maxillary narrow, reaching beyond middle of pupil,  $2\frac{1}{2}$  head; teeth small, close set, nearly uniform, in a single row.

Gillrakers slender, smooth, 14 to 16 below arch, the longest nearly one-half diameter of orbit. Eyes large, separated by a narrow, knife-like ridge, which is naked, or with a single series of scales. Scales small, firm, rough, those on tail roughest, those on blind side similar, mostly smooth anteriorly. Lateral line rising anteriorly, but without arch; dorsal beginning immediately in front of pupil; anal preceded by a spine; caudal long; pectoral of eyed side one-half length of head; ventral reaching past front of anal; pectoral and ventral of eyed side with prickle-like scales. Brownish, nearly uniform, sometimes spotted with darker; fins grayish, irregularly blotched with dusky. Body sometimes sinistral. Length, 18 inches. Bering Sea south to Cape Flattery; a rather abundant shore fish in Puget Sound, and it seems to be still more common northward, being, in Alaska, a food-fish of some importance. Abundant north and south of the Aleutian Islands and in Bristol Bay. Recorded by Schmidt from the Sea of Okhotsk.

Our specimens from Kamchatka agree in all respects; D. 77 to 84; A. 60 or 61. Pectoral not quite one-half head. Interorbital ridge sharp, with 1 series of scales; gillrakers  $x + 14$ .

( $\epsilon\lambda\alpha\sigma\sigma\acute{o}\omega$ , to diminish;  $\acute{o}\delta\acute{o}\upsilon\varsigma$ , tooth.)

#### 20. HIPPOGLOSSOIDES HAMILTONI Jordan and Gilbert.

*Hippoglossoides hamiltoni* JORDAN and GILBERT, Rept. Fur Seal Invest., III, 1899, p. 489, pl. LXXXIV (Dalnoi Point, Kamchatka) (Coll. *Albatross*).—JORDAN and EVERMANN, Fish. North Mid. Amer., III, 1898, p. 2611 (Kamchatka).—SCHMIDT, Faune Mer. Jap. Och., 1903, p. 19 (Okhotsk Sea); Pisc. Mar. Orient, 1904, p. 226 (Terpienia, Okhotsk Sea).

*Habitat*.—Okhotsk Sea.

Head,  $3\frac{1}{5}$  in length; depth,  $2\frac{2}{5}$ ; longest diameter of upper eye,  $3\frac{1}{2}$  in head; snout (measured from upper eye) 5 in head; maxillary of colored side,  $2\frac{1}{3}$ , of blind side,  $2\frac{1}{5}$ , in head; depth of caudal peduncle equaling its length,  $3\frac{1}{3}$  in head; D. 72; A. 56; P. 11; pores in lateral line 91. Upper profile of head continuing the dorsal curve without interruption, there being a slight depression above the eye and an increased convexity on the snout; mandible very heavy, projecting anteriorly, so that its symphyseal profile completes the curve of the snout; a very short prominence at symphysis directed vertically downward; gape strongly curved and the mouth narrowed anteriorly, so that the maxillary and premaxillary are almost wholly concealed along the middle of their length by the overarching prefrontal; teeth acute, in a single series in each jaw, all except the anterior teeth in each jaw short; at the symphysis of lower jaw the teeth are longer and directed inward, while in the anterior end of each premaxillary the teeth are still more enlarged, and the series on each side describes a strong curve with its convex side toward the median line; maxillary reaching vertical from slightly behind middle of lower eye; nostril tubes conspicuous, the anterior in closest proximity to the upper lip, which it entirely over-

hangs; posterior nostril tube wider and slightly shorter; eyes of nearly equal size, and opposite, separated by a wider ridge than in *H. elassodon*, the ridge bearing in its narrowest portion 2 well-defined rows of strongly spinous scales; a conspicuous series of pores joining lateral line with upper margin of upper eye, and another encircling the lower eye below and behind; a third series along mandible and preopercle; 1 large pore above posterior nostril; gillrakers slender, unarmed, 2 above the angle, 11 or 12 below it, the longest  $2\frac{3}{4}$  in eye; dorsal fin beginning above front of pupil, the longest ray  $2\frac{5}{8}$  in head; anal preceded by a strong spine, its height equaling that of dorsal; pectoral very long and slender,  $\frac{2}{3}$  length of head, that of blind side shorter,  $\frac{1}{2}$  length of head; ventrals reaching to base of fourth or fifth anal ray, caudal long, evenly rounded behind, the middle rays not longer than those adjacent, their length equaling distance from tip of snout to preopercular margin; scales on colored side strongly ctenoid except in

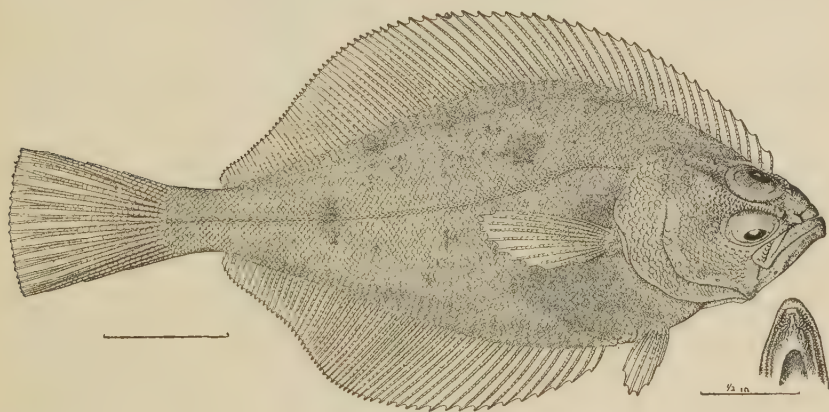


FIG. 9.—HIPPOGLOSSOIDES HAMILTONI.

a strip along middle of sides anteriorly; elsewhere each scale provided with 2 to 4 long spines; on blind side they are smooth except on nape and caudal peduncle; cheeks, opercles, and interorbital space covered with larger, rougher scales than those on sides; mandible and snout naked; a single series surrounding each eye anteriorly, and 1 on maxillary or colored side; blind side of head with maxillary naked; cheeks covered with minute smooth thin scales, the opercles with a few scattered spinous scales, the preopercle naked. Color nearly uniform brownish, without distinctive markings on body or fins.

The type is 17 cm. long, from off Dalnoi Point, Kamchatka; depth, 16 fathoms. It is also recorded from the sea of Okhotsk.

(Named for Gerald Edwin H. Barrett-Hamilton, of Dublin, member of the British Commission of Fur Seal Investigation, 1896 and 1897, who made valuable collections of Kamchatkan fishes.)



## 11. CLEISTHENES Jordan and Starks.

*Cleisthenes* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902 (1904), p. 622 (*pinetorum*).

This genus is closely allied to *Hippoglossoides*, differing in having cycloid scales everywhere in the young, and an increased number of gillrakers. The adult has a single row of ctenoid scales along anterior base of dorsal and anal, a few on snout on ridge behind interorbital space, and on opercle. The dorsal begins at the orbital rim slightly on the blind side. Eyes and color on right side. Teeth in a single row.

(*Cleisthenes*, the effeminate, an Athenian noted by Aristophanes.)

## 21. CLEISTHENES PINETORUM Jordan and Starks.

*Cleisthenes pinetorum* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902 (1904), p. 622, plate (Kinkwazan Island, Bay of Matsushima).

*Habitat*.—Matsushima, in deep water.

Head, 3.66 in length; depth, 2.6; D. 76; A. 56; scales, 80; upper eye, 4.6 in head; snout from upper eye, 4.6; pectoral of eyed side, 2; of blind side, 2.5; ventral, 3; caudal, 1.4.

Dorsal outline of anterior part of body and head an even concave curve to near tip of snout, broken only by protruding upper eye. Upper eye cutting into profile, and ranging nearly vertically upward, about two-fifths of it being visible from the blind side. Tip of snout blunt and rounded; mouth rather strongly curved; maxillary reaching scarcely to middle of lower eye, not covered along middle of its length by the prefrontal; teeth small, acute, in a single series in each jaw, scarcely enlarged anteriorly; nostrils moderate, the anterior in a short tube which does not reach to edge of preorbital; preorbital with a blunt spine on anterior edge; eyes about equal in size, separated by a flat interspace, covered with cycloid scales; gillrakers slender, equal to half the eye in length, 8 to 10 above and 24 to 27 below the angle.

Dorsal fin beginning slightly on blind side at edge of orbit opposite posterior margin of pupil; anal preceded by a strong spine; ventrals not reaching to anal (reaching to base of second anal ray in young); caudal evenly rounded behind; scales everywhere cycloid and with concentric rings in specimens 4 or 5 inches long.

A specimen 10 inches long has cycloid scales except a single row of ctenoid scales along base of dorsal and anal anteriorly, a few in front and behind the interorbital space, and some on opercles. The type (8.5 inches long) has only an occasional ctenoid scale along base of dorsal and anal, and the ctenoid scales on head are very sparse. A specimen 7 inches long has only a few ctenoid scales remaining on head behind interorbital space.



Color everywhere dark brown, dorsal and anal a little lighter at base of rays; membrane of caudal darker than the rays making longitudinal streaks; dorsal, anal, and caudal of blind side dark toward tips of rays.

Numerous specimens were dredged off Kinkwazan Island, Matsushima Bay, at stations 3769 and 3770. The type is 22 cm. in length,

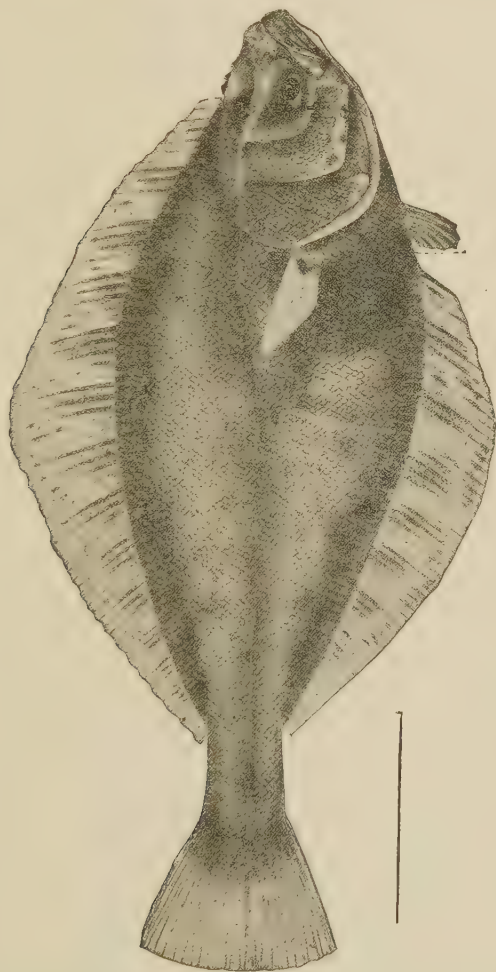


FIG. 10.—CLEISTHENES PINETORUM.

Cat. No. 51403, U.S.N.M.; cotypes are No. 8391, Stanford University.

(*pinetorum*, of the pines; in reference to Matsushima Bay: matsu, pine; shima, island.)

## 12. PROTOPSETTA Schmidt.

*Protopsetta* SCHMIDT, Pisc. Mar. Orient, 1904, p. 230 (*herzensteini*).

This genus is allied to *Hippoglossoides*, differing in the insertion of the upper eye, which is placed on the upper outline of the head, as in

*Atheresthes* and *Reinhardtius*. The dorsal begins over the posterior part of the eye, and the teeth are rather small and close together.

The fin rays are in relatively small numbers (D. 74, A. 54), and the vertebræ also (11 + 29), characters which separate this genus from *Reinhardtius*. The caudal fin is truncate and not lunate. Okhotsk Sea. ( $\pi\rho\acute{\omega}\tau\omicron\varsigma$ , first;  $\psi\eta\tau\tau\alpha$ , flounder.)

## 22. PROTOPSETTA HERZENSTEINI (Schmidt).

*Hippoglossoides herzensteini* SCHMIDT, Pisc. Mar. Orient, 1904, p. 229 (Broughton Bay, Gensan, Korea, Bay of Paris at Vladivostok, Mauka, North Coast of Saghalin, Lake Khalizan).

*Habitat*.—Japan Sea and Okhotsk Sea, south to Korea.

Dorsal, 70 to 75; anal, 53 to 56; pectoral, 11; ventral, 6; scales, 82 to 84; vertebræ, 11 + 29 = 40.

Upper eye with its range vertical and a little posterior to lower eye. Teeth very small, sharp, and recurved; in two rows on lower jaw. Head covered with scales covered by skin and armed above with sharp bony papillæ; interorbital space rough and almost equal in width to short diameter of lower eye; front nostrils ending in short tubes; gillrakers, 7 + 16, the longest equal to the vertical diameter of lower eye; body of eyed side covered with ctenoid scales. Some of the scales, especially anteriorly, have in addition to the marginal spinules rough bony papillæ on their surface; lateral line nearly straight and unbranched; height of caudal peduncle equal to its length; no anal spine; vertebræ, 11 + 29.

Origin of dorsal somewhat on blind side and opposite beginning of the posterior fourth of upper eye; first ray equal in length to half the diameter of upper eye, the longest rays equal to combined length of snout and eye; rays of dorsal and anal covered with small rough plates; caudal truncate; covered almost to tip with small scales.

Color, uniform brown without markings; the fins all dark.

This species is here described from the account given by Doctor Schmidt. We have specimens from Port Arthur.

(Named for the late Dr. Solomon Herzenstein, of the Imperial Academy of Sciences, St. Petersburg.)

## 13. HIPPOGLOSSUS Cuvier.

*Hippoglossus* CUVIER, Règne Animal, 1st ed., II, 1817, p. 221 (*hippoglossus*).

Eyes and color on the right side. Form oblong, not strongly compressed. Mouth wide, oblique; teeth in the upper jaw in 2 series, those below in 1; anterior teeth in upper jaw, and lateral teeth in lower, strong; no teeth on vomer or palatines; lower pharyngeal teeth in 2 rows. Dorsal fin beginning above the eye, its middle rays elevated, the posterior rays of dorsal and anal bifid; caudal fin lunate; ventral fins both lateral. Scales very small, cycloid; lateral line with

a strong curve in front. Gillrakers few, short, compressed, wide set. Vertebrae, 16+34. Largest of the flounders. This genus contains the well-known halibut; abundant on both coasts of the North Atlantic and of the North Pacific.

(*hippoglossus*, the ancient name of the halibut from ἵππος, horse; γλῶσσα, tongue.)

### 23. HIPPOGLOSSUS STENOLEPIS Schmidt.

*Hippoglossus stenolepis* SCHMIDT, Faune Mer. Och. Jap., 1903, p. 19 (Okhotsk Sea, name only); Pisc. Mar. Orient, 1904, p. 224 (Gulf of Aneva).

*Habitat*.—Okhotsk Sea, probably south to Hokkaido.

Head, 4.5 in length; depth, 3.3; eye, 8.2 in head, 2 in snout; mandible, 2.8 in head; least depth of caudal peduncle, 4.6 in depth of body; dorsal, 95; anal, 74; pectoral, 17; caudal, 16; branchiostegals, 6.

General shape of body as in *Hippoglossus hippoglossus*, the head more blunt and convex; eyes equal in size, on right side, and separated by a space  $1\frac{1}{3}$  times the length of the upper eye; teeth large, in two rows on upper jaw, in a single row on sides of lower jaw and in double row in front; scales everywhere cycloid and covered by skin; at the posterior end of some of them a rough bony plate, which is easily detached; no supplementary scales.

Origin of dorsal opposite front of pupil, its greatest height one-third of depth of body; length of pectoral equal to postorbital part of head; caudal somewhat concave; ventral reaching beyond front of anal.

Color, olive brown with bright spots corresponding to the bony plates.

This species differs from *H. hippoglossus* in the construction of its scales and in having a smaller number of fin rays and gillrakers. Length of specimen described, 1047 millimeters. (Schmidt.)

It is known to us solely from Schmidt's account. It seems to replace the common halibut in the Sea of Okhotsk.

(στενός, narrow; λεπίς, scale).

### 14. REINHARDTIUS Gill.

*Reinhardtius* GILL, Cat. Fishes, East Coast N. A., 1861, p. 50 (*hippoglossoides*; no description).

*Platysomatichthys* BLEEKER, Comptes Rendus, Ac. Sci. Amsterdam, XIII, 1862, p. 426 (*pinguis*=*hippoglossoides*).

*Reinhardtius* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 218 (*hippoglossoides*).

Eyes and color on right side. Body more or less elongate, compressed; head long and large; mouth large; maxillary reaching beyond eye; jaws with strong, unequal teeth, the upper with 2 series in front, these converging behind; lower jaw with a single series of strong, distant teeth; no teeth on vomer or palatines. Gillrakers few, short, stout, and rough. Fins rather low; caudal fin lunate. Lower pharyngeal teeth in one row. Scales small, cycloid; lateral line without

anterior curve. Fin rays and vertebræ numerous, as in the halibut. Two species known, arctic fishes, in some degree intermediate between the true halibut and *Atheresthes*.

(Named for Prof. Johann Reinhardt, of the University of Copenhagen, an able investigator of the fishes of Greenland).

24. REINHARDTIUS MATSUURÆ Jordan and Snyder.

*Hippoglossus greenlandicus* ISHIKAWA and MATSUURA, Prel. Cat., 1897, p. 25 (Sagami Bay). (Not of AUTHORS.)

*Reinhardtius matsuuræ* JORDAN and SNYDER, Journ. Coll. Sci. Imp. Univ., XV, 1901, p. 309, pl. XVI, figs. 7, 8 (Sagami Bay).

*Habitat*.—Sagami Bay, probably in deep water.

Head,  $4\frac{1}{4}$  in length; depth,  $3\frac{1}{2}$ ; dorsal, 96; anal, 69; scales, 117.

Body dextral; interorbital width 3 in maxillary; a little less than longitudinal diameter of lower eye; cleft of mouth same on both sides; lateral line single, not sharply curved anywhere, running obliquely downward to a point a little above middle of body and posterior to base of pectoral a distance equal to 2 times length of maxillary, then straight backward to end of caudal fin, similar on blind side; dorsal fin inserted just behind eye; anal inserted below 26th dorsal ray; dorsal and anal extending an equal distance posteriorly; length of caudal peduncle  $2\frac{1}{2}$  times in head; minute scales on interradiat membrane of both dorsal and anal; length of pectoral equal to maxillary.

Color plain brown.

A stuffed specimen about  $1\frac{1}{4}$  feet long, No. 456, Imperial Museum, Tokyo. Locality Misaki. This species is allied to *Reinhardtius hippoglossoides*, the Greenland Halibut, differing in the larger scales and in other characters. No second specimen is known.

(Named for Mr. K. Matsuura, curator of fishes in the Imperial University Museum at Tokyo.)

13. ATHERESTHES Jordan and Gilbert.

*Atheresthes* JORDAN and GILBERT, Proc. U. S. Nat. Mus., 1880, p. 51 (*stomias*).

Eyes and color on the right side. Body very long and slender, closely compressed, tapering into a long and slender caudal peduncle; head elongate, narrow; mouth extremely large, oblique; the long and narrow maxillary extending beyond the eye; each jaw with 2 irregular series of sharp, unequal, arrow-shaped teeth, some of them long and wide set, and others short and close set, sharp; the long teeth freely depressible. Gill rakers numerous, long, slender, and stiff, strongly dentate within. Scales rather large, thin and readily deciduous, slightly ciliated, those on the blind side similar, smooth; lateral line without arch. Fins low and fragile; dorsal beginning over the eye, its anterior rays low, the posterior rays somewhat forked; no anal spine; pectorals and ventrals small, both of the latter lateral; caudal lunate.



A genus of subarctic flounders, doubtless degenerate, rather than primitive in its traits.

(ἀθήρ, the beard or spike of an ear of corn; ἐσθίω, to eat; from the arrow-shaped teeth.)



FIG. 11.—ATHERESTHES EVERMANNI.

25. *ATHERESTHES EVERMANNI* Jordan and Starks.

*Atheresthes evermanni* JORDAN and STARKS, Bull. U. S. Fish Commission, XXII, 1902 (1904), p. 630, pl. v, fig. 1 (Matsushima Bay).

*Habitat*.—Matsushima Bay, in deep water.

Head, 3.3 in length; depth, 3; D. 114; A. 94; scales, 109; upper

eye, 4.75 in head; snout from upper eye, 4; maxillary, 1.9; pectoral of eyed side, 2.1; of blind side, 3.25; upper lobe of caudal, 1.75.

Profile of snout on same curve with that behind eye; very slightly depressed above eye; eyes scarcely reaching to upper profile, the lower one the more anterior; interorbital appearing rather flat and moderately broad, the bone, however, narrow and convex, its width less than half diameter of pupil; nostrils close together, the posterior of eyed side in a broad, short tube, anterior in a narrower, longer tube; anterior nostril of blind side with a long flap nearly a third as long as upper eye, broadening toward its tip and becoming conspicuously opaque white; snout with many pores scattered among the irregularly placed scales; mouth reaching to or very slightly past the vertical from posterior margin of lower eye; teeth long and slender and with lance-shaped points, in a single row on lower jaw, their length unequal; a double row of smaller teeth on side of upper jaw, the outer row the smaller; they grow larger anteriorly, become curved inward, fang-like and some of them depressible; gill rakers rather slender, the longest a trifle less than half length of eye, their number 3+10; scales very finely ctenoid, the spinules short, fine, and numerous, only seen upon careful examination with a lens; many scales have only a few irregular spinules; others are entirely without them, appearing as if they had been rubbed off; head and body everywhere with numerous, small, cycloid supplementary scales crowded in; scales of blind side all cycloid; snout, mandible, maxillary, and interorbital with numerous small cycloid scales, those on latter extending out on eyeball to edge of iris; all fins rather closely covered with fine scales; lateral line slightly bending upward from opposite tip of pectoral. Pectoral of eyed side longer and more pointed than that of blind side; first ray of dorsal inserted above anterior margin of pupil; ventral short, scarcely reaching to front of anal. Caudal shallowly concave on posterior outline.

Color uniformly dark brown, without markings.

This species differs from *Atheresthes stomias*, of the Alaskan fauna, in having only a single row of teeth on lower jaw, and the upper eye not reaching the upper profile. The scales are more strongly ctenoid and the anterior nostril bears a long flap.

The type and sole specimen is 270 cm. in length; it is from station 3772 in Matsushima Bay, and is numbered 51490, U.S.N.M.

(Named for Dr. Barton Warren Evermann.)

#### 16. ALÆOPS Jordan and Starks.

*Alæops* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902 (1904), p. 623 (*plinthus*).

This genus is allied to *Pacilopsetta*. Body covered with large ctenoid scales which are somewhat caducous; eyes and color on the right

side; lateral line simple, with a broad flat-topped arch in front; mouth moderate; teeth small in bands; gillrakers short and sharp.  
( $\alpha$ , not;  $\lambda\alpha\iota\acute{o}\varsigma$ , left;  $\acute{\omega}\psi$ , eye.)



FIG. 12.—ALÆOPS PLINTHUS.

26. ALÆOPS PLINTHUS Jordan and Starks.

*Alæops plinthus* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902 (1904), p. 623, pl. v, fig. 2 (Suruga Bay, Owari Bay).

*Habitat*.—Southeast coast of Japan, in deep water.

Head, 4 in length; depth, 2.4; D. 61; A. 53; scales, 65 (pores);

upper eye, 3 in head; snout from upper eye, 4.16; maxillary, 3.16; pectoral of eyed side, 2.25; ventral median; caudal rays, 1.

Anterior body outline strongly arched above; orbital rim of upper eye protruding beyond rest of profile; snout a little produced, blunt; anterior nostril in rather broad, short tube, which does not reach to edge of preorbital; maxillary curved, reaching to below or very slightly past anterior rim of pupil of lower eye; teeth small, in a very narrow band on eyed side, growing wider anteriorly, somewhat smaller on premaxillary. On blind side the teeth on both jaws are in moderately wide bands. Eyes equal in size, the lower slightly more anterior, separated by a narrow naked ridge; vertical limb of premaxillary short; gillrakers short and rather sharp, the longest one-half to one-third diameter of pupil, 5+10 in number; caudal peduncle very wide and flat, its length one-third of its width; scales large, rather finely but very evidently ctenoid on eyed side, cycloid on blind side; head on eyed side, anterior to posterior rim of pupil above, and posterior end of mandible below, without scales; lateral line turning abruptly upward at a sharp angle two-thirds the head's length behind head, and forming a conspicuous flat-topped arch, as high as half length of head; dorsal beginning slightly on blind side, a little behind middle of eye, length of first ray contained 1.1 in upper eye, longest rays near posterior end of fin, the longest 2.25 in head; pectorals equal in size; caudal broad and pointed behind; no lateral angles, the sides broadly rounded from tips of the long median rays to lateral edges of fin base.

Color pinkish slaty-brown, usually mottled with black; 2 inconspicuous semiocellated spots, one near dorsal and one near anal base a head's length anterior to base of caudal; less conspicuous dark irregular spots along side above anal and below dorsal, one below arch of lateral line; a black spot on outer rays of caudal; all fins except ventral and pectoral of blind side irregularly spotted and mottled with black. The membrane has drawn away from the scales in our specimen leaving them light at base.

The type is 155 mm. in entire length, taken at station 3708 in Suruga Bay. It is numbered 51406, U. S. N. M.

Others were taken in Suruga Bay and in Owari Bay.

(*πλίνθος*, tile, from the color.)

#### 17. PLEURONICHTHYS Girard.

*Pleuronichthys* GIRARD, Proc. Ac. Nat. Sci. Phila., 1854, p. 139 (*cænosus*).

*Heteroprosopon* BLEEKER, Comptes Rendus Acad. Amsterdam, XIII, 1862, p. 8 (*cornutus*).

*Parophrys* GÜNTHER, Cat. Fishes, IV, 1862, p. 454; not of GIRARD.

Eyes and color on the right side. Body deep; head short, with very short, blunt snout; mouth small, with several series of slender, acute



teeth, which are most developed on the blind side, and are often wanting in one or both jaws on the colored side; no teeth on vomer or palatines; lips thick, with several lengthwise folds within which is a series of short fringes. Lower pharyngeals narrow, each with a double row of very small teeth. Gillrakers wide set, very short and weak. Lateral line nearly straight, with a dorsal branch in our species. Scales small, cycloid, nonimbricate, embedded. Dorsal fin anteriorly twisted from the dorsal ridge toward the blind side; anal fin preceded by a spine; caudal fin convex behind. Intestinal canal elongate. Herbivorous species, feeding chiefly on algæ. Pacific Ocean.

The species of *Pleuronichthys* spawn in the spring and live in comparatively deep water. The protruding eyes are both turned to the right side very early in specimens  $\frac{1}{2}$  inch long.

(πλευρόν, side; ἰχθύς, fish.)

## 27. PLEURONICHTHYS CORNUTUS (Schlegel).

BIKIKAREI (FROG-FLOUNDER); MOCHIGAREI (RICE-CAKE-FLOUNDER);

MITIGAREI (BOARD-FLOUNDER); OMIGAREI (FLOUNDER OF OMI).

*Platissa cornuta* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 179, pl. xc, fig. 1 (Nagasaki).—BLEEKER, Verh. Bat. Gen., XXVI, Japan, p. 121.

*Heteroprosopon cornutus* BLEEKER, Compt. Rend. Ac. Sci. Amst., 1862, Pleuron., p. 8 (Nagasaki).

*Parophrys cornuta* GÜNTHER, Cat. Fish, IV, 1862, p. 455 (copied); Shore Fishes, Challenger, 1880, p. 70 (Kobe).—NAMIYE, Class. Cat., 1881, p. 110 (Tokyo).—ISHIKAWA and MATSU'URA, Prel. Cat., 1897, p. 24 (Yeshigo).—OTAKI, Journ. Bur. Fish, 1897, p. 7, pl. viii, p. 90 (Japan).

*Pleuronichthys cornutus* STEINDACHNER, Reise Aurora, 1896, p. 217 (Kobe).—JORDAN and EVERMANN, Fish. North Mid. Amer., III, 1898, p. 2637 (Japan).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 769 (Yokohama); p. 900 (Hakodate, Tokyo).—JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902 (1904), p. 923 (Suruga Bay).

*Habitat*.—Entire coast of Japan, north to Hakodate.

Head, from 4 to  $4\frac{2}{5}$  in length without caudal; depth,  $1\frac{2}{3}$  to  $1\frac{1}{2}$ . Upper eye,  $3\frac{1}{2}$  to 4 in head; snout to upper eye, 5; maxillary,  $4\frac{1}{2}$ . Dorsal, 70 to 76; anal, 52 to 54. Scales, 80.

Mouth very small; the maxillary reaching to below anterior margin of pupil. Teeth in villiform bands, mostly on the blind side of mouth. Eyes large; opposite each other; separated by a sharp, naked ridge. A strong sharp spine, directed backward, on interorbital ridge opposite posterior margin of eyes; another, directed outward, and curved slightly backward, on anterior part of ridge, a little behind front of eyes; a short-pointed tubercle of bone directed forward at tip of snout; and a similar one directed outward in front of each eye. Gillrakers scarcely developed; 4 or 5 small tubercles on lower part of arch.

Scales small and embedded; not imbricated anteriorly. Origin of dorsal on blind side at a point a little above the level of front of premaxillary, and opposite middle of upper eye. Longest dorsal rays equal to those of anal and contained  $1\frac{1}{2}$  in head. Pectorals bluntly

pointed; that of eyed side  $1\frac{3}{5}$  to  $1\frac{4}{5}$  in head; that of blind side two-thirds as long as its mate and contained  $2\frac{1}{3}$  in head. Ventral of blind side placed more anteriorly and farther from the ventral ridge of body than its mate. Caudal rounded.

Color rather light gray, everywhere spotted with irregular, or more or less round spots of dark brown. These are sometimes very small and scattered, sometimes lighter in the center, or arranged in irregular rings, or sometimes large and narrowly separated. The edges of the vertical fins are dusky or dark brown on the blind side. A few specimens were colored and spotted on both sides and in these cases the front of the dorsal is usually not on the blind side, but is on a free lobe which overhangs the head; the upper eye is more on the dorsal outline of the head than in normal examples; the ventrals are usually more symmetrical; and the pectorals are both of the same length, these characters possibly indicating that the fish may swim on either side.

We have numerous specimens from Kobe, Aomori, Hiroshima, Nagasaki, Hakodate, Onomichi, Wakanoura, Tsuruga, Tokyo, and Misaki. This species is one of the commonest of the small flounders of Japan.

(*cornutus*, horned.)

#### 18. LEPIDOPSETTA Gill.

*Lepidopsetta* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 195 (*umbrosus*).

Body robust; mouth small. Teeth stout, conical, little compressed,

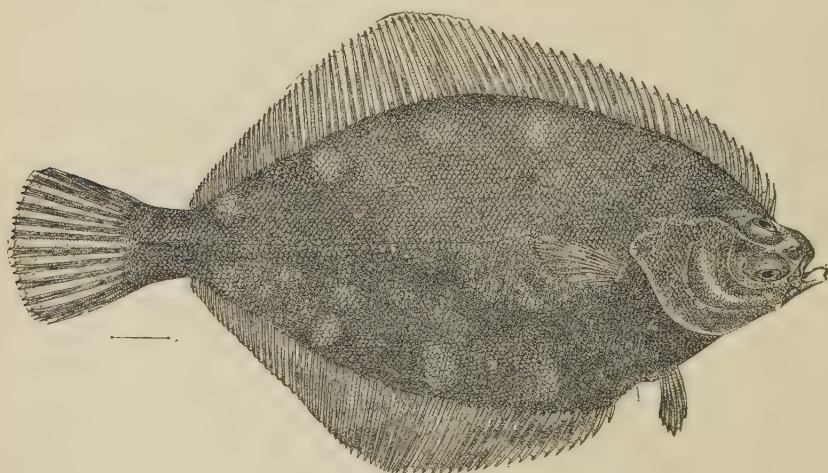


FIG. 13.—LEPIDOPSETTA BILINEATA.

bluntish, in one series, rather irregularly placed. Lateral line with a distinct arch in front and accessory dorsal branch; scales imbricated, rough ctenoid, smooth in the very young. A single species, abundant on the Pacific coasts. It is close to *Limanda*, from which the accessory branch of the lateral line alone separates it.

(λεπίς, scale; ψῆττα, flounder.)

## 28. LEPIDOPSETTA BILINEATA (Ayres).

*Platessa bilineata* AYRES, Proc. Ac. Nat. Sci. Cal., 1855, p. 40 (San Francisco).

*Platichthys umbrosus* GIRARD, Proc. Ac. Nat. Sci. Phila., 1856, p. 136 (Puget Sound).

*Pleuronectes perarcuatus* COPE, Proc. Ac. Nat. Sci. Phila., 1873, p. 30 (Unalaska).

*Pleuronectes umbrosus* GÜNTHER, Cat., IV, 1862, p. 454.

*Pleuronectes bilineatus* GÜNTHER, Cat., IV, 1862, p. 444.—JORDAN and GILBERT, Synopsis, p. 833, 1883.

*Lepidopsetta bilineata* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 195.—LOCKINGTON, Proc. U. S. Nat. Mus., 1879, p. 103; Rep. Com. Fisheries, California, 1878-79, p. 46.—JORDAN and GILBERT, Proc. U. S. Nat. Mus., 1880, p. 453; Proc. U. S. Nat. Mus., 1881, p. 68.—BEAN, Proc. U. S. Nat. Mus., 1881, p. 241; Cat. Coll. Fish. U. S. Nat. Mus., 1883, p. 19; Proc. U. S. Nat. Mus., 1883, p. 353.—JORDAN, Nat. Hist. Aquat. Anim., 1884, p. 184, pl. L.—JORDAN and GOSS, Review Flounders and Soles, 1889, p. 286.—JORDAN and EVERMANN, Bull. Fish North. Mid. Amer., III, 1898, p. 2643, pl. CCCLXXVI, fig. 928 (Alaska, etc.).—SCHMIDT, Poiss. Mar. Orient, 1904, p. 232 (Bay of Shogun, Shendagen, Japan, Mauka, Gensan, Atka).

*Habitat*.—Bering Sea, south to Monterey and to Korea.

Head,  $3\frac{3}{5}$ ; depth,  $2\frac{1}{8}$ . D. 80; A. 60; teeth,  $\frac{27+7}{25+10}$ ; scales 85. Ventrals  $11+29=40$ . Body, broadly ovate, thickish; mouth moderate, turned toward the left side; teeth stout, conical little compressed, bluntish, in one series, rather irregularly placed. Lower pharyngeals broad, with two rows of blunt teeth. Gillrakers few, very short, thick and weak, without teeth. Snout projecting; eyes large, separated by a prominent ridge, which, like the cheeks and upper portion of opercle, is covered with rough stellate scales; lower eye advanced; opercle, subopercle, and interopercle of left side scaly; preopercle naked. Scales rather small, mostly ctenoid, not closely imbricated, those on the blind side smooth; scales on cheeks and other parts of head very rough; scales of body smoother and less closely imbricated anteriorly, the degree of roughness variable, northern specimens (var. *umbrosus*) being roughest. Lateral line moderately arched anteriorly, with an accessory dorsal branch, which is less than one-half length of head; height of arch less than one-third its length. Dorsal beginning over eye, its anterior rays low; caudal convex; anal preceded by a spine; a concealed spine behind ventrals; rays of dorsal and anal all simple; dorsal and anal somewhat scaly; caudal three-fifths length of head; pectoral one-half head. Lower pharyngeals broad, each with two rows of blunt teeth. Yellowish brown, with numerous round, pale blotches. Pacific coast of America and Northern Asia, Bering Strait to Monterey and to Sakhalin. This species is one of the commonest of the flounders of the Pacific coast, its abundance apparently increasing toward the northward. In Bering Sea it far outnumbers all other flounders. Schmidt records it from the Sea of Ochotsk and the Sea of Japan.

## 19. LIMANDA Gottsche.

*Limanda* GOTTSCHÉ, Archiv für Naturgesch., 1835, p. 100 (*limanda*).

*Myzopsetta* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 217 (*ferruginea*).

*Limandella* JORDAN and STARKS, new subgenus (*yokohamæ*).

Teeth uniserial; lateral line with a distinct arch in front, and without accessory dorsal branch; scales more or less imbricated, rough ctenoid in the typical species but cycloid in one of the Japanese species; vertebræ about 40. This genus is closely allied to *Pseudopleuronectes*, from which it differs only in the presence of an arch on the anterior part of the lateral line.

Color of eyed side brownish; the blind side usually washed with rusty red or with yellow in life.

The genus may be divided into two groups in accordance with the dentition. In *Limanda* proper, the teeth are bluntish conical not close set, in an irregular row, which extends on the blind side of each jaw. In certain Japanese species (*Limandella*) the teeth are broad, truncate, evenly set, restricted mainly to the blind side of each jaw.

## KEY TO SPECIES.

- a. LIMANDA.—Teeth conical, in an irregular row extending on eyed side of jaws.
  - b. Dorsal rays about 66; anal rays about 50.
    - c. Scales about 80, those of blind side rough; snout not projecting....*aspera*, 29
    - cc. Scales about 90, those of blind side smooth; snout produced...*proboscidea*, 30
  - bb. Dorsal rays about 60; anal about 45; scales about 70; a rough area behind eye; scales all cycloid .....*iridorum*, 31
- aa. LIMANDELLA.—Teeth broad, truncate, close-set, confined chiefly to the blind side of each jaw.
  - d. Dorsal rays, 62; anal, 48; scales, 75 .....*schrencki*, 32
  - dd. Dorsal rays, 65 to 75; anal rays, 50 to 55; scales, 75 to 80.
    - e. Head with the snout slender and produced .....*angustirostris*, 33
    - ee. Head with the snout not notably produced.....*yokohamæ*, 34

## 29. LIMANDA ASPERA (Pallas).

*Pleuronectes asper* PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 425 (east coast of Siberia).—GÜNTHER, Cat., IV, 1862, p. 454.—STEINDACHNER, Pleuronectiden, etc., aus Decastris Bay, 1870-1875.—JORDAN and GILBERT, Synopsis, 1883, p. 835.

*Limanda aspera* BEAN, Proc. U. S. Nat. Mus., 1881, p. 242, Cat. Coll. Fish, U. S. Nat. Mus., 1883, p. 20; Proc. U. S. Nat. Mus., 1883, p. 354; Hist. Aquat. Anim., 1884, p. 184, pl. XLVIII.—JORDAN and GOSS, Review Flounders and Soles, 1889, p. 288.—JORDAN and EVERMANN, Fish, North and Middle Amer., III, 1898, p. 2645, pl. CCCLXXVII, fig. 930 (Alaska to Saghalin).—JORDAN and GILBERT, Rept. Fur Seal Exp., III, p. 491 (Robben Reef, Petropaulski, etc.).—SCHMIDT, Pisc. Mar. Orient, 1904, p. 233 (Mauka, Usta, Gulf of Aniva, Papou).

*Habitat*.—Bering Sea and Okhotsk Sea.

Head,  $3\frac{1}{2}$ ; depth, 2. D. 69; A. 53; scales, about 80. Form of *Lepidopsetta bilineata*. Teeth small almost conical, on both sides of the mouth; interorbital space narrow, scaly; opercle and preopercle



naked below; gillrakers very feeble; pharyngeals not very broad, their teeth bluntish, not paved; scales small, wide apart, partly embedded, each one with 1 to 4 spinules, which are almost erect; anterior scales with 3 to 4 of these spinules; posterior mostly with 1; scales of blind side smoother; only middle rays of dorsal and anal scaly; no accessory lateral line; anal spine present; twentieth anal ray and thirty-seventh dorsal ray longest; caudal, double truncate. Brown, nearly plain, the blind side with tinges of lemon yellow. Bering Sea, generally common, south to Vancouver Island and to the Okhotsk Sea. We have specimens from Petropaulski and Robben Reef, Bristol Bay, and Herendeen Bay.

(*asper*, rough.)

### 30. LIMANDA PROBOSCIDEA Gilbert.

*Limanda proboscidea* GILBERT, Rept. U. S. Fish Com. for 1893 (1896) p. 460, pl. xxxiii (Bristol Bay, Herendeen Bay).—JORDAN and GILBERT, Rept. Fur Seal Expl., III, 1898, p. 491 (Bristol Bay, Herendeen Bay).—JORDAN and EVERMANN, Fish North and Mid. Amer., III, 1898, p. 2645 (Bristol Bay, Herendeen Bay).—SCHMIDT, Faune Mer Och. Jap., 1903, p. 19 (Okhotsk Sea) Pisc. Mar Orient, 1904, p. 236 (Mauka, Ustil R., Lutogi, Moloro R. Okhotsk Sea).

*Habitat*.—Bering Sea, Okhotsk Sea.

Depth,  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in length; head, large, 3 to  $3\frac{1}{5}$  in length in a specimen 7 inches long. D. 63 to 67; A. 47 to 49; scales, 86 to 95. Resembling *L. ferruginea*, but having fewer rays in dorsal and anal, larger scales and longer snout. Profile sharply angulated above front of upper eye, the snout convexly protruding; form varying from very slender to broadly elliptical, the 2 outlines equally curved; caudal peduncle short, widening backward, its least depth twice its length; mouth oblique, maxillary reaching beyond front of lower eye, 4 in head; teeth narrow, little compressed, in a single series on both sides of the jaw, extending farther back on the blind side; eyes on right side; lower eye well in advance of upper, the diameter of upper eye  $5\frac{1}{2}$  to 6 in head,  $1\frac{1}{2}$  in snout; vertical from front of upper eye, falling midway between front of orbit and front of pupil of lower eye; inter-orbital space a very narrow, sharp ridge, naked in females, with a single series of ctenoid scales in males; gillrakers short, about equal to diameter of pupil, 13 or 14 in number, 9 or 10 on lower limb; scales loosely imbricated, ctenoid in males on colored side, smooth in females; blind side of both sexes smooth; head scaled on eyed side in males; the opercle, subopercle, interopercle, and preopercle mostly naked in females; head on blind side naked; rays of vertical fins with a single series of ctenoid scales; dorsal fin beginning slightly behind front of upper eye, the first 3 rays usually higher and with membranes more deeply incised than in those which follow; highest portions of both dorsal and anal fins behind the middle of the body; these fins about equal, their longest rays equal to the snout and eye; caudal two-thirds

head; pectorals short, one-third in head; ventrals reaching beyond front of anal,  $3\frac{1}{3}$  in head; the usual small antrorse spine in front of anal fin. Color light grayish or brownish, thickly covered with small whitish spots; entire left side with margins of dorsal, caudal, and anal fins bright lemon yellow (as in *Limanda ferruginea*); vertical fins grayish, with an occasional dark-brown ray. Specimens described  $7\frac{1}{2}$  inches long. Bering Sea, Bristol Bay; Herendeen Bay.

(*proboscideus*, having a long snout or proboscis.)

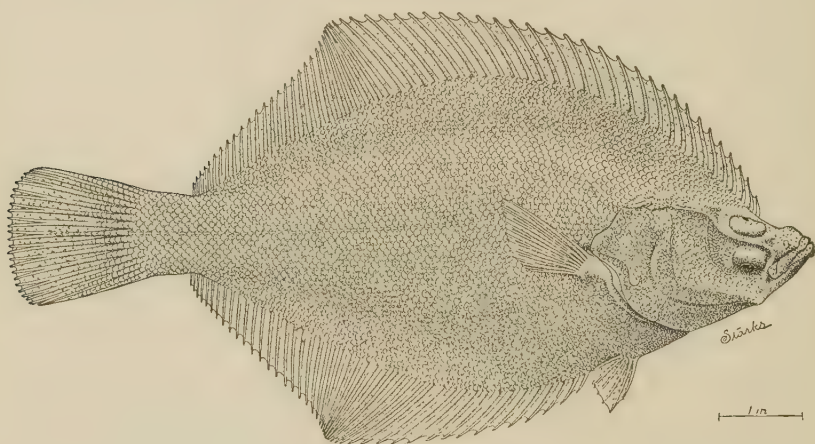


Fig. 14.—*LIMANDA IRIDORUM*.

31. *LIMANDA IRIDORUM* Jordan and Starks, new species.

*Habitat*.—Seas of Hokkaido.

Head, 3 to  $3\frac{1}{4}$  in length to base of caudal; depth,  $1\frac{1}{2}$  to  $2\frac{1}{4}$ . Eye,  $6\frac{1}{2}$  in head; maxillary,  $\frac{1}{2}$  to  $1\frac{1}{4}$ ; snout,  $\frac{1}{2}$  to 5. Dorsal, 57 to 63; anal, 44 to 46. Pores of lateral line, 66 to 72.

Upper outline of head very concave; the snout produced and turned upward; the backward extending processes from the premaxillaries forming a prominent projection on the upper edge of the snout. A vertical line drawn upward from the posterior edge of the lower eye cuts through the beginning of the posterior fourth of the upper eye. Interorbital space a very high, sharp, naked ridge; smooth between eyes, but becoming rough directly behind them and passing into a rather broad rugose area running above opercles to beginning of lateral line. A similar rough area following ridge of preopercle. A rough ridge, rather high anteriorly, running from snout to beginning of lateral line on blind side of head. Mouth rather large and oblique; the maxillary reaching to edge of lower orbital cavity. Mandible oblique and rather straight; its posterior end forming a prominent angle on ventral outline; its tip projecting beyond snout. Teeth rather sharp and irregular, in an uneven row on both sides of jaws,

but extending farther around on blind side. Gillrakers pointed, the longest equal to half the diameter of lower eye; 11 developed on lower limb of arch.

Scales everywhere cycloid, embedded anteriorly and not imbricate, posteriorly they are slightly imbricate and not embedded. Height of lateral line curve equal to long diameter of upper eye; length of curve equal to half the length of head.

Pectoral rather pointed, reaching past curve of lateral line; its length equal to half length of head. Origin of dorsal slightly on blind side, opposite front of upper eye. Ventral of blind side a little anterior to that of eyed side. Caudal slightly rounded and angulated at tips of outer rays.

Slate color, finely speckled, and spotted all over by small, brown, irregular marks; these especially conspicuous on the fins.

This species somewhat resembles *L. proboscidea*, but may be at once known by its larger cycloid scales.

It is represented by six specimens from Mororan, Aomori, and Hakodate.

The type is from Mororan, and is 25 cm. in length. It is numbered 55644, U.S.N.M.

A cotype is No. 9824, Stanford University.

(*iridorum* of the iris; from Mororan, which means Iris-huts).

### 32. LIMANDA SCHRENCKI Schmidt.

*Limanda schrencki* SCHMIDT, Faune Mer. Okhotsk, Japan, 1903, p. 19 (Japan Sea, Okhotsk Sea), (name only); Pisc. Mar. Orient, 1904, p. 235 (Aneva, Mauka, Saghalin).

*Habitat*.—Japan Sea.

Head, 4 to  $4\frac{1}{2}$  in length; depth 2 to  $2\frac{1}{2}$ . Eye  $5\frac{7}{10}$  to  $6\frac{9}{10}$  in head. Dorsal 61 to 63; anal 47 to 49; scales 75 to 78.

Eyes about equal in size; the lower are slightly the more anterior; interorbital space less than half the length of upper eye. Nostrils ending in tubes, the anterior are the longer. Lips thick and fleshy; upper jaw with 12 to 15 teeth on blind side, none on colored side, except in one specimen, which has 2; lower jaw with 15 to 17 on blind side; 2 to 4 on colored side. Two rows of blunt, flat teeth on lower pharyngeals; 12 to 15 in each row. Lateral line rough, with a bony outgrowth. Whole head covered with ctenoid scales, except between eyes and on cheek; nape with large scales.

Color of fins and body dark brown, with yellow spots and 6 to 9 black spots in life; often a black spot at tip of blind side of caudal. Japan Sea (Schmidt). Not seen by us.

This species is nearest to *L. yokohamæ*, but has fewer fin rays; the eyes are smaller than in other species.

(a personal name.)



33. *LIMANDA ANGUSTIROSTRIS* Kitahara, new species.

*Habitat*.—Shores of Hokkaido.

Head,  $2\frac{1}{5}$  to  $4\frac{1}{6}$  in length to base of caudal; depth,  $2\frac{1}{4}$ . Upper eye, 5 to  $5\frac{1}{2}$  in head; snout,  $5\frac{1}{4}$  to  $5\frac{1}{2}$ ; maxillary,  $4\frac{1}{3}$  to  $4\frac{1}{2}$ . Dorsal, 68 to 74; anal, 52 to 55. Pores in lateral line, 74 to 78.

Head rather slender, the snout produced, forming a conspicuously concavity in outline above upper eye. Upper eye a little posterior to lower. Interorbital space, a high, sharp, naked ridge. Maxillary reaching to anterior edge of lower eye, a little past front of orbital cavity. Twenty-two to 24 teeth on blind side of lower jaw, 5 or 6 on the other side; 19 to 22 on blind side of upper jaw, none on the other. Gillrakers short, flat, and pointed, 6 on lower limb of arch.

Dorsal beginning above middle of upper eye or sometimes a little in front of middle. Pectoral pointed; its length  $1\frac{3}{4}$  to  $1\frac{1}{2}$  in head; its

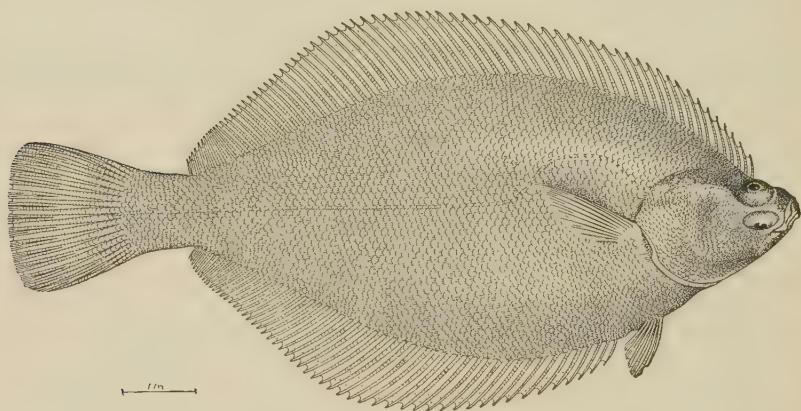


FIG. 15.—*LIMANDA ANGUSTIROSTRIS*.

tip reaching to, or a little past, angle of lateral line. Caudal very slightly convex, angulated at tips of outer rays.

Scales large, embedded, and not imbricated; 13 to 15 scales between middle of lateral line curve and back; 21 to 24 between angle of lateral line and anal. In *L. yokohamæ* there are from 22 to 25 scales in the same place on back, and from 30 to 36 on lower part of sides. Scales everywhere cycloid except on posterior half of eyed side of body. Height of curve of lateral line equal to length of upper orbital cavity; length of curve contained  $1\frac{1}{3}$  to  $1\frac{1}{2}$  in head.

Color uniform slaty brown, without definite markings. The unpaired fins lighter; no color on blind side.

This species differs from *Limanda yokohamæ* in having the snout more pointed, the head more slender, the teeth smaller, the interorbital space sharper, higher and naked, the scales farther apart, more embedded, and fewer of them counting transversely. The ridge running from upper eye to lateral line is more rugose.



We have eight specimens taken at Aomori. The type is 28 cm. in length and is numbered 55645, U.S.N.M. Cotypes are No. 9825, Stanford University.

Mr. T. Kitahara of the Imperial Fisheries Bureau, sends us a manuscript description of this species, from a specimen from Aomori. We adopt the specific name chosen by him in place of the one we had devised.

(*angustus*, narrow; *rostrum*, snout.)

#### 34. LIMANDA YOKOHAMÆ (Günther).

AKAGAREI (RED-FLOUNDER); AMATE OR YAMATE (FLOUNDER).

*Pleuronectes yokohamæ* GÜNTHER, Shore Fishes Challenger, 1880, p. 69 (Inland Sea of Japan, Yokohama).—OTAKI, Journ. Bur. Fish., 1897, p. 6, pl. vi, fig. 4.

*Limanda yokohamæ* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 379, 1900 (Tokyo, Hakodate); Check List, 1901, p. 121 (Yokohama).

*Pleuronectes japonicus* HERZENSTEIN, Bull. Ac. Sci. Petersb., 1894, p. 130 (Hakodate, Vladivostok). (Not *Pleuronectes japonicus* Houttuyn.)

*Limanda japonica* SCHMIDT, Faune Mer. Jap. Och., 1903, p. 19 (Japan Sea); Pisc. Mar. Orient, 1904, p. 234 (Mayka, Hakodate, Vladivostok).

*Limanda herzensteini* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 746, 1901, after Herzenstein.—JORDAN and STARKS, Bull. U. S. Fish. Comm., XXII, 1904, p. 623 (Matsushima Bay, scales 84 (88 pores); Tsuruga, Matsushima, Hakodate, Aomori, scales 80 to 85).

*Habitat*.—All shores of Japan, north to Vladivostok, south to Obama.

Head,  $4\frac{1}{5}$  to  $4\frac{2}{5}$  in length to base of caudal; depth,  $2\frac{1}{5}$  to  $2\frac{3}{5}$ . Upper eye,  $5\frac{1}{2}$  in head; snout, 6; maxillary, 4. Dorsal, 65 to 70; anal, 50 to 53. Pores in lateral line, 77 to 80.

Head rather small, a depression above upper eye at beginning of dorsal. Snout short, slightly produced but not so much as in *L. angustirostris*. Upper eye a little posterior to lower. Interorbital space not very high, slightly convex and covered with small ctenoid scales, its width equal to one-third of long diameter of upper eye. Maxillary reaching a little past front of lower eye. Fifteen or 16 teeth on left side of lower jaw, 4 or 5 on right side; 14 on left side of upper jaw, none on right side.

Dorsal beginning over anterior third of upper eye. Pectoral of right side from  $1\frac{1}{2}$  to  $1\frac{3}{5}$  in head, that of left side from 2 to  $2\frac{1}{2}$  in head. Caudal convex, slightly angulated at tips of outer rays. Scales of blind side cycloid, those of eyed side usually strongly ctenoid, sometimes cycloid on anterior part of back and cheek.

Color of eyed side uniform dark brown, or indistinctly blotched with lighter brown. Caudal usually colorless on blind side, but sometimes irregularly placed, and more or less conspicuous even on the blind side. In some these spots are very distinct, in others wholly obsolete. Blind side in life washed with rusty red.

This is one of the most abundant of Japanese shore flounders, being everywhere common.

We have numerous specimens from Mororan, Hakodate, Aomori, Tsuruga, Onomichi, Yokohama, Tokyo, and Kobe. We have also a photograph of a specimen from Uzen in Echigo. Mr. Kitahara records it, in letter, from Obama in Kiusiu. The species is unusually variable.

(From Yokohama; *yoko*, flat; *hama*, beach.)

## 20. VERÆQUA Jordan and Starks.

*Veraequa* JORDAN and STARKS, Bull. U. S. Fish Comm., XX, 1904, p. 628 (*achne*).

Allied to *Microstomus* and to *Limanda*.

Body rather elongate, covered with very fine cycloid scales; lateral line with a small arch in front, without accessory dorsal branch; mouth small and with about 7 large blunt teeth in a single row on blind side; eyes close together, separated by a high naked ridge which is continued backward; gillrakers very small, not numerous; no anal spine; caudal rounded; eyes and color on right side.

## 35. VERÆQUA ACHNE Jordan and Starks.

*Veraequa achne* JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1904, p. 625, pl. VII, fig. 1 (Matsushima Bay).

*Habitat*.—Matsushima Bay in deep water.

Head, 4.33 in length; depth, 2.87; D. 85; A. 69; scales, 135; upper eye, 3.16 in head; snout from upper eye, 4; pectoral, 2; ventral, 4; highest dorsal rays, 2; caudal, 1.1.

Form rather slender, the outlines forming low even curves; anterior upper outline of head unbroken and continuous with body curve; mouth very small, the maxillary reaching a little past front of lower eye but scarcely to edge of pupil; 7 large and very blunt teeth, set in a single row on blind side only; eyes narrowly separated by a high naked ridge, the lower the more anterior; interorbital ridge continued backward and upward along lower margin of upper eye, forming a high, conspicuous, smooth ridge; a slight angle on lower edge where it turns upward, but no tubercles developed; nostrils close together, in short broad tubes, anterior reaching to edge of preorbital; gill slit stopping at upper edge of pectoral; gillrakers very small—8 on lower limb of arch. Scales very fine, everywhere cycloid; very small non-imbricated scales present on dorsal and anal nearly to tips of rays except on the brown streak behind each ray; caudal thickly covered with similar scales; scales on pectoral rays only; on base of ventral only on both rays and membrane; small imbedded scales on snout; lateral line perfectly straight and horizontal to tip of pectoral, where it turns up and forms a low but conspicuous arch, the cord of its curve 3 times its height. Dorsal beginning slightly on blind side above middle of eye;

low anteriorly, gradually growing higher to beginning of its last third or fourth, where it reaches its greatest height; pectorals rounded, that of eyed side, in our specimen, very slightly longer than that of blind



FIG. 16.—*VERREQUA ACHNE*.

side; ventral short and rather broad, the second ray longest, making the fin pointed; caudal broadly rounded.

Color slaty brown, mottled with darker brown blended into the ground color; a brown streak behind and partly on each dorsal and anal ray; caudal uniform dark brown; pectoral with dark brown membrane.

A single specimen, the type, dredged at station 3772, Matsushima Bay, in 79 fathoms. It is 18 cm. in length, and is numbered 51447 U.S.N.M.

(ἄχρη, a whiff of foam.)

## 21. DEXISTES Jordan and Starks.

*Devistes* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1904, p. 624 (*rikuzenius*).

This genus differs from *Pseudopleuronectes* in having large scales, and the large eyes narrowly separated by a high, sharp, naked inter-orbital ridge. Eyeball scaly above. Eyes and color on the right side.

Body fragile.

(δεξιός, right handed.)

## 36. DEXISTES RIKUZENIUS Jordan and Starks.

*Devistes rikuzenius* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1904, p. 624, pl. vi, fig. 1 (Matsushima Bay, Suruga Bay).

*Habitat*.—Shores of eastern Japan in deep waters.

Head, 3.83 in length; depth, 2.75; D. 73; A. 59; scales 64 (pores); upper eye, 3.1 in head; snout from upper eye, 4.83; maxillary of eyed side, 3.83; of blind side, 3; pectoral of eyed side, 2; of blind side, 3; ventral, 3.1; highest dorsal rays, 2.5; median caudal rays, 1.5.

Body moderately narrow; anterior dorsal curve slightly broken by the raised orbital rim; snout blunt, lower jaw projecting, and with a knob developed at symphysis below tip; eyes large, upper slightly the larger and placed farther back; narrowly separated by a high sharp, naked ridge; mouth much larger on blind side; maxillary of eyed side reaching to opposite anterior edge of pupil; teeth blunt and not very even or closely set, in one moderately straight row except on blind side of lower jaw, where three or four are irregularly placed inside the row; gillrakers short and triangular, 7 on lower limb of arch, 1 developed and 2 rudimentary ones on upper limb; scales large and ctenoid on eyed side, cycloid on blind side; spinules on scales very slender, sharp, and numerous; a few scales on anterior part of inter-orbital where it widens on snout; upper eye with a patch of ctenoid scales, each with two or three spinules; a row of small scales running out on each fin ray; lateral line without an arch, a branch of it curves down behind eyes and around lower edge of lower eye; dorsal beginning above middle of eye; pectoral of eyed side longer and more pointed than that of blind side; ventrals equal in length, the last rays the longest; median caudal rays produced, upper edge obliquely truncate, lower slightly concave.

Color brown, with a few irregular inconspicuous dark brown spots, one on lateral line at beginning of its posterior two-fifths, one near base of caudal, one below middle of lateral line, one near top of pectoral; small ones show little color except a few brown spots, the one on lateral line the most conspicuous.



The type from which this description is taken is 22 cm. in length, and was taken at station 3774, in Matsushima Bay, in 84 fathoms. Two small cotypes were taken at station 3717, off Ose Point, Suruga Bay, in 65 to 125 fathoms.

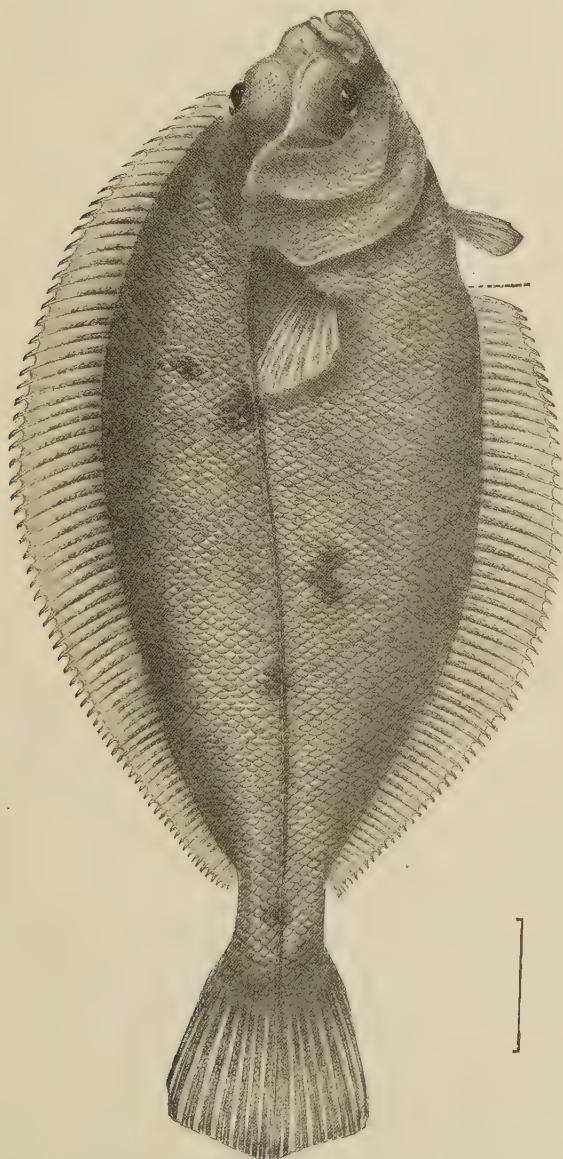


FIG. 17.—DEXISTES RIKUZENIUS.

The type is Cat. No. 51423, U.S.N.M. A cotype is No. 8388, Stanford University.

(Name from the province of Rikuzen, in which Matsushima Bay is located.

## 22. ARAIAS Jordan and Starks.

*Araias* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1904, p. 624 (*ariommus*).

This genus is also a degenerate ally of *Pseudopleuronectes*. It is very close to *Dexistes*, the only tangible character of importance being the naked eyeball. The eyeballs are scaly above in *Dexistes*. The body is still more fragile than in *Dexistes*, and the scales are thinner. (*ἀραιός*, thin.)

## 37. ARAIAS ARIOMMUS Jordan and Starks.

*Araias ariommus* JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1904, p. 624, pl. VI, fig. 2 (Matsushima Bay).

*Habitat*.—Matsushima Bay in deep water.

Head, 3.8 in length; depth, 2.6; D. 71 to 74; A. 57 to 60; scale, 60; upper eye, 2.8 in head; snout from upper eye, 4.33; maxillary, 3.75; pectoral of eyed side, 1.87; of blind side, 2.75; caudal, 1.16.

Rim of upper orbit very slightly protruding above rest of upper profile; eyes separated by a narrow sharp ridge; anterior rim of lower eye scarcely or very slightly anterior to that of upper, posterior rim anterior to that of upper (to a greater degree in the type than in cotype); mouth very small, considerably larger on blind side, the maxillary reaching to just below anterior edge of orbit; teeth blunt, set in a single, very irregular row, those of lower jaw projecting around on eyed side farther than those of premaxillary; gillrakers short and triangular, 3+7 on first arch; dorsal beginning above middle of upper eye; pectoral of eyed side a little longer and not so bluntly rounded as that of blind side; caudal doubly truncate, median rays the longer; lateral line not arched, gradually curved up anteriorly; scales cycloid, with occasionally a ctenoid scale with long irregular spinules (as the spinules are easily broken, leaving no trace, it appears probable that the scales may have all been ctenoid); a few small scales running out on fin rays.

Color light pinkish brown, without definite markings; dorsal, anal, and caudal with very faint wavy cross marks.

Two specimens taken in Matsushima Bay, at stations 3770 and 3773. The type is the larger, and is 13 cm. in length. It is Cat. No. 51417, U.S.N.M. The other from station 3773 is No. 8386, Stanford University.

(*ἄρι*, large; *ὄμμα*, eye.)

## 23. PLEURONECTES (Artedi) Linnæus.

*Pleuronectes* ARTEDI, Genera, etc., in part, 1738, p. 16.

*Pleuronectes* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 268 (*platessa*); included all known *Pleuronectidae*.

*Platessa* CUVIER, Règne Animal, 1st ed., II, 1817, p. 220 (*platessa*).

*Pleuronectes* SWAINSON, Nat. Hist. Class'n Anim., II, 1839, p. 302 (*platessa*).

*Pleuronectes* BLEEKER, Comptes Rendus Acad. Amsterd., XIII, 1862 (*platessa*); and of most recent authors.

Body oblong, with firm flesh. Mouth small, teeth uniserial, incisor-like, compressed, forming a continuous cutting edge. Lateral line straightish, without arch or accessory dorsal branch. Scales imper-

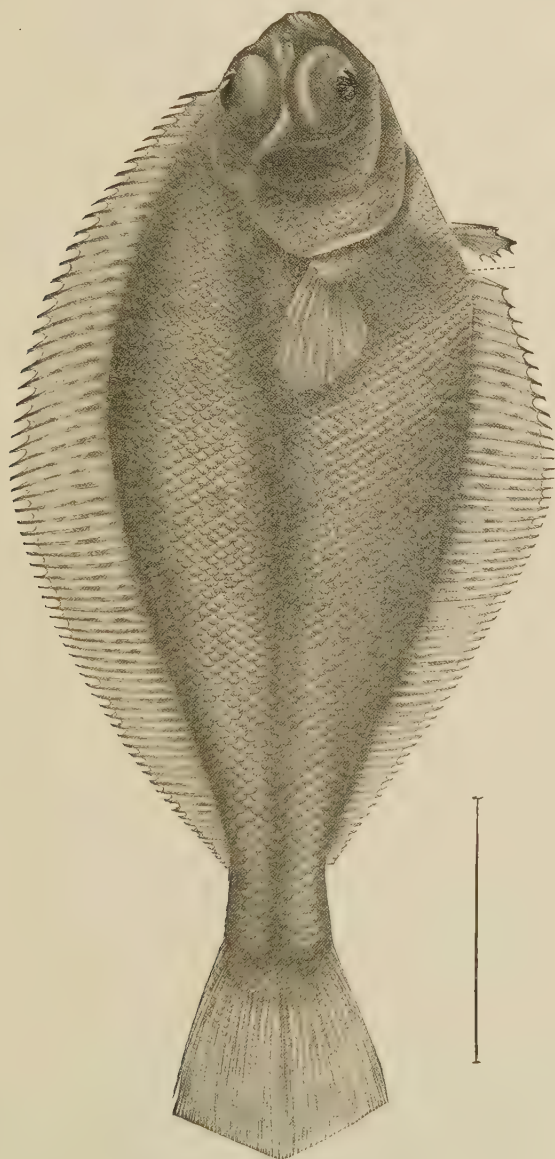


FIG. 18.—*ARALIAS ARIOMUS*.

fectly imbricated, chiefly cycloid in both sexes; lower pharyngeals small and narrow, separate, each with one or two rows of small bluntish teeth. No stellate scales along bases of dorsal and anal. A row of bony tubercles behind eye. Species mostly European, valued as food, typified by the common Plaice, *Pleuronectes platessa*.

(πλευρόν, side; νήκτης, swimmer.)

38. *PLEURONECTES QUADRITUBERCULATUS* Pallas.

*Pleuronectes quadrituberculatus* PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 423 (sea between Kamchatka and Alaska).—BEAN, Proc. U. S. Nat. Mus., 1881, p. 241.—JORDAN and GILBERT, Synopsis, 1883, p. 836; Fur Seal Expl., III, 1898, p. 491 (Robben I, Avatcha Bay).—JORDAN and EVERMANN, Fish North Mid. Amer., III, 1898, p. 2648 (Bering Sea; Robben I, etc.).—SCHMIDT, Pisc. Mar. Orient, 1904, p. 239 (Gulf of Aneiva, Gulf of Sakhalin, Popora).

*Parophrys quadrituberculatus* GÜNTHER, Cat., LV., 1862, p. 456.

*Platessa quadrituberculata* JORDAN and GOSS, Review Flounders and Soles, 1889, p. 292.

*Pleuronectes pallasii* STEINDACHNER, Ichth. Beitr., VIII, 1879, p. 45 (Kamchatka).

*Habitat*.—Bering Sea, Japan Sea, south to Southern Sakhalin.

Head,  $3\frac{2}{3}$ ; depth, 2. D. 68; A. 50; scales, 78. Mouth very small, with small, incisor-like teeth, rounded at tip. Eyes separated by a narrow ridge; about 5 small, prominent, conical, obtuse, bony tubercles in a row above the opercle, continuous with the direction of the lateral line, which is straight, without accessory dorsal branch; tubercle above opercle largest. Scales small, cycloid in all specimens examined. Anal spine present. Grayish, mottled with paler and with round black spots; fins very dark. Bering Sea on both coasts, south to Kodiak and Okhotsk Sea. Our specimens from Avatcha Bay, Bristol Bay, Herendeen Bay, Chernofsky Harbor, Grantley Harbor, Chignik Bay, and Robben Island. The above description from a small specimen (Cat. No. 28025, U.S.N.M.) collected by Mr. W. J. Fisher at Kodiak. The species proves to be a true *Pleuronectes*, having the lower pharyngeals narrow, separate, with 2 rows of bluntish teeth.

(*quadrituberculatus*, having four tubercles.)

24. *LIOPSETTA* Gill.

*Liopsetta* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 217 (*glaber*); females.

*Euchalarodus* GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 222 (*putnami*); males.

Teeth chiefly uniserial, incisor-like; scales imperfectly imbricated, rough ctenoid in the male, more or less cycloid in the female (fin rays scaly in the male, naked in the female); lower pharyngeals very large, more or less united in the adult, their surface somewhat concave, with teeth in 5 or 6 rows, large, blunt, close set; lateral line without arch or dorsal branch. This genus comprises several species of small flounders of the Arctic seas. The genus is distinguished by the large, half-united pharyngeals, as also by the peculiar squamation, the scales in the males being very rough, in the females smooth. This difference has given rise to the nominal genus *Euchalarodus*, based on the males, while *Liopsetta* was based on the smoother females, which were erroneously supposed to be scaleless.

(λεῖτος, smooth; ψῆττα, flounder.)

## KEY TO SPECIES.

- a. Dorsal rays 59 to 62; anal 45 to 46; scales 80, dark brown, the fins barred *obscura*. 39  
aa. Dorsal rays 58; anal rays 38; scales 70; brown, the fins barred... *pinnifasciata*. 40



## 39. LIOPSETTA OBSCURA (Herzenstein).

*Pleuronectes obscurus* HERZENSTEIN, Mélanges Biologiques, 1890, p. 127 (Chemulpo, Vladivostok).

*Liopsetta obscura* JORDAN and GILBERT, Rep. Fur Seal Invest., III, 1898, p. 492 (Iturup).—JORDAN and EVERMANN, Fish North Mid. Amer., III, p. 2657 (Iturup).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 379 (Iturup).—SCHMIDT, Pise. Mar. Orient., 1904, p. 244 (Vladivostok, Mayka, Chemulpo).

*Habitat*.—Okhotsk Sea, south to Kuril Islands.

Dorsal rays, 59 to 62; anal, 45 to 46; tubes, 79. Head,  $3\frac{1}{10}$ ; depth,  $2\frac{1}{5}$ ; scales in males everywhere strongly ctenoid, smooth in females; interorbital space covered with very fine scales, not naked; curve of the lateral line marked, its cord contained 5 times in the straight portion; the pectoral of colored side  $1\frac{3}{5}$  head, the caudal  $1\frac{1}{5}$ , the ventral  $\frac{1}{2}$  head, and the highest dorsal ray  $1\frac{3}{5}$ . Lower pharyngeals short and broad, the two closely appressed but united in our specimens, 27 and 29 cm. long. The teeth are large and very blunt, like cobble stones, and are arranged in 1 row along the outer edge, a row of larger teeth along the inner edge, and a short row along the posterior edge of the triangle. Color on eyed side uniform dark brown on body and fins, the extreme tips of the fin rays white; on blind side yellowish white, with a few irregular scattered dark spots; dorsal and anal yellowish at base, becoming more or less mottled with dusky on distal half, the fins marked with broad dark bars parallel with the rays, about 7 on the anal fin, 10 or 11 on the dorsal; caudal light on basal half more or less blotched with darker, becoming black posteriorly. The young from 9 to 15 cm. long have the scales perfectly smooth, but in other respects they agree perfectly with the adult males, except in their more varied coloration; head and body brownish, profusely spotted in coarser or finer pattern with light gray; also with a few scattered black spots edged with gray; markings on the fins as described for adults. Sea of Okhotsk. Our specimens from Shana Bay, Iturup Island, one of the Kurils, originally described from Vladivostok.

(*obscurus*, dark.)

## 40. LIOPSETTA PINNIFASCIATA (Kner).

*Pleuronectes pinnifasciatus* KNER, in Steindachner, Ueber einige Pleuronectiden, etc., aus Decastris Bay, 1870, p. 422, pl. I, fig. 1 (Decastris Bay, mouth of Amur River).—JORDAN and GOSS, Review Flounders and Soles, 1889, p. 290—JORDAN and EVERMANN, Fish North Mid. Amer., III, 1898, p. 2649.

*Liopsetta pinnifasciata* SCHMIDT, Fauna Mer. Okhot. Japan, 1903, p. 19 (Okhotsk Sea); Mar. Orient, 1904, p. 245 (mouth of Amur, Lintog, Busse Bay, etc.).

*Habitat*.—Japan Sea, from Amur River to Kamchatka.

Head,  $3\frac{1}{4}$  in body; depth,  $2\frac{1}{5}$ . D. 58; A. 38; scales, 70; eye,  $5\frac{3}{5}$  in head; the highest anal ray, 2; pectoral, 2; caudal,  $4\frac{1}{2}$  in body. Body

subelliptical, the snout rather pointed and not forming an angle above eye; mouth rather small, maxillary reaching scarcely to the middle of the lower eye; interorbital space rather broad, one-half width of eye; a rather prominent rugose ridge above opercle, with a smaller similar ridge behind it; both sides of jaws with teeth, those on blind side stronger; origin of dorsal over middle of upper eye. Color brown, with vague dusky spots; 6 or 7 blackish vertical bars on dorsal and anal; similar lengthwise blotches on caudal. Okhotsk Sea, east to Kamchatka (Steindachner.) Not seen by us.

Schmidt refers the species to *Liopsetta*, to which it probably belongs. (*pinna*, fin; *fasciatus*, banded).

## 25. PLATICHTHYS Girard.

*Platichthys* GIRARD, Proc. Ac. Nat. Sci. Phila., 1854, p. 136 (*rugosus*=*stellatus*).

Body very robust, broad, not greatly compressed. Mouth small; teeth chiefly uniserial, incisor-like. Scales all in both sexes and on both sides of body reduced to coarse scattered stellate tubercles, which are not imbricated; similar tubercles between bases of dorsal and anal rays; lateral line without scales, with no anterior arch or accessory lateral line; lower pharyngeals broad, each with 3 rows of blunt coarse teeth. A single species, the largest of the small-mouthed flounders, and distinguished from related forms chiefly by the development of coarse stellate tubercles instead of scales.

(πλατύς, flat; ἰχθύς, fish.)

## 41. PLATICHTHYS STELLATUS (Pallas).

TAKANOHAGAREI (HAWK'S CREST FLOUNDER); NUMAGAREI (SWAMP FLOUNDER).

*Pleuronectes stellatus* PALLAS, Zoographia Rosso-Asiatica, III, 1811, p. 416 (Kamchatka, Aleutian, and Kuril Islands).—GÜNTHER, Cat., LV, 1862, p. 443.—STEINDACHNER, Pleur. von Decastris Bay, 1870, p. 1.—JORDAN and GILBERT, Proc. U. S. Nat. Mus., III, 1880, p. 453; IV, 1881, p. 68.—BEAN, Proc. U. S. Nat. Mus., IV, 1881, p. 420.—JORDAN and GILBERT, Synopsis, 1883, p. 835.—BEAN, Proc. U. S. Nat. Mus., VI, 1883, p. 353; Cat. Coll. Fish., U. S. Nat. Mus., 1883, p. 20.—JORDAN, Nat. Hist. Aquat. Anim., 1884, p. 184, pl. XLVI.—OTAKI, Journ. Bureau Fish., 1897, p. 7, pl. vi, fig. 6 (Northern Japan).—ISHIKAWA and MATSU'ŪRA, Prel. Cat., p. 25 (Hokkaido).

*Platessa stellata* DE KAY, N. Y. Fauna, Fishes, 1842, p. 301.—STORER, Synopsis, 1846, p. 478.

*Platichthys stellatus* LOCKINGTON, Rep. Com. Fish. Cal., 1878-79, p. 43; Proc. U. S. Nat. Mus., 1879, p. 91.—JORDAN and GOSS, Review Flounders and Soles, 1889, p. 296.—JORDAN and EVERMANN, Fish. North. Mid. Am., 1898, III, p. 2652 (Robben I., Saghalin, Alaska, California, etc.).—JORDAN and GILBERT, Fur Seal Explr., III, 1898, p. 492 (Alaska, etc.).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 379 (Robben I).—SCHMIDT, Faune Pisc. Mar. Orient, 1904, p. 240 (Japan Sea; Ochotsk Sea; Vladivostok; Mayka; Makhodka; Arakul; Shumanshin; Amur River; Petropaulsky; Hakodate; Saghalin).

*Platichthys rugosus* GIRARD, Proc. Ac. Nat. Sci. Phila., 1854, pp. 139, 155 (San Francisco; Presidio; Petaluma).—GIRARD, U. S. Pac. R. R. Surv., X, Fishes, 1858, p. 148.

*Habitat*.—North Pacific on both coasts, south to Tokyo and to San Luis Obispo.

Head,  $3\frac{2}{5}$ ; depth, 2. D. 58; A. 42. Vertebrae, 34. Body, broad and short, the snout forming a slight angle with the profile; lower jaw projecting; interocular space rather broad, with very rather rough scales; large rough scales at base of dorsal and anal rays and on sides of head; similar but smaller scales scattered over the body; lateral line smooth; fins without scales; a cluster of bony prominences above opercle. Teeth incisor-like, truncate, rather broad,  $\frac{10+15}{12+16}$ . Lower pharyngeals broad, with coarse paved teeth. Dark brown or nearly black, with lighter markings; fins reddish brown; dorsal and anal with 4 or 5 vertical black bands; caudal with 3 or 4 black longitudinal

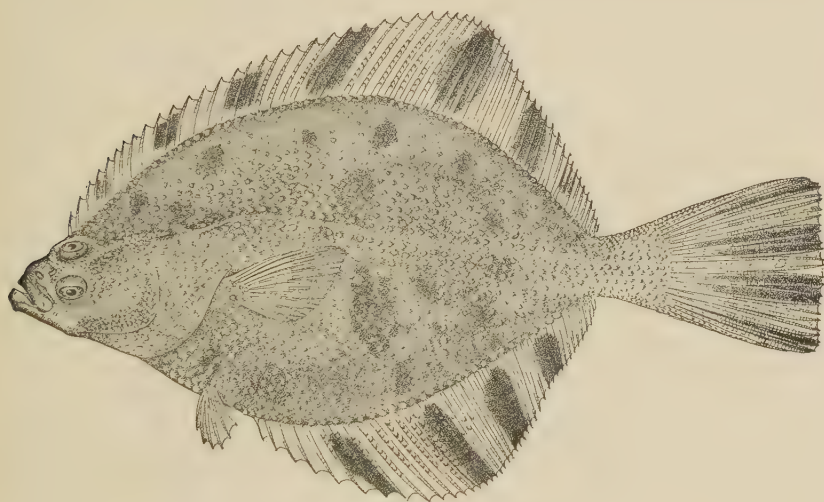


FIG. 19.—*PLATICTHYS STELLATUS*.

bands. Pacific coast of America, from Point Concepcion to the Arctic Ocean and south to northern Japan. This is one of the largest of the American flounders, reaching a weight of 15 to 20 pounds. Of the small-mouthed flounders it is much the largest species known. It is an abundant species, constituting half the total catch of flounders on the Pacific coast of America, and it is equally abundant in Bering Sea. It lives in shallow water and sometimes ascends the larger rivers. It is one of the most widely distributed of all the flounders, its range extending from San Luis Obispo, California, to the mouth of the Anderson and Colville rivers on the Arctic coast, and to Port Clarence, thence across to Japan, whence we have specimens from Mororan, Hakodate, Aomori, Same, Matsushima, and Tokyo. We have also specimens from Petropaulski, Bering, Medni, and Robben islands. Also seen from Bristol Bay and Saghalon. It is a coarse fish, not valued as food, either in Japan or America.

(*stellatus*, starred.)

## 26. KAREIUS Jordan and Snyder.

*Kareius* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 379  
(*scutifer*=*bicoloratus*).

This genus is allied to *Pleuronectes* and *Liopsetta*, differing in the scaleless body, the adult having two or three irregular bony or warty areas on the eyed side. Teeth even, in one row.  
(*karei*, flounder in Japanese.)

## 42. KAREIUS BICOLORATUS (Basilewsky).

ISHIGAREI (ROCK FLOUNDER); MAKOGAREI (MAKO FLOUNDER); YANAGIMUSHIGAREI  
(WILLOW WORM FLOUNDER).

*Platessa bicoloratus* BASILEWSKY, Nom. Mem. Soc. Moscow, X, 1855, p. 260  
(Shantung).

*Pleuronectes bicoloratus* HERZENSTEIN, Bull. Ac. Sci. Petersb., 1890, p. 133.

*Kareius bicoloratus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1901, p. 769  
(Yokohama).—SCHMIDT, Pisc. Mar. Orient, 1904, p. 243 (Gensan, Hakodate, Manchuria).

*Pleuronectes scutifer* STEINDACHNER, Sitzber. Akad. Wiss. Wien, XXI, p. 628, pl. II  
(Chifu).—OTAKI, Journ. Bur. Fish, 1897, VII, pl. vi, fig. 5 (Japan).

*Kareius scutifer* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 379  
(Tokyo); Check List, 1901, p. 122 (Hakodate, Yokohama).

*Habitat*.—Coasts of Japan, south to Tokyo, also in northern China.

Head,  $3\frac{1}{2}$  inches in length to base of caudal; depth,  $2\frac{2}{5}$ . Eye,  $5\frac{1}{2}$  in head; maxillary, 4; snout, 5; dorsal, 69; anal, 50.

Body moderately slender, the upper anterior outline concave opposite front of eye, and the snout somewhat produced, but without an abrupt sharp notch. Upper eye slightly more posterior than lower. Interorbital space flat, rather narrow, and not elevated; its entire width two-thirds of diameter of pupil, bone only one-third. Mouth arched; maxillary reaching to below anterior edge of pupil of lower eye. Teeth compressed and set in a single, even, row on both sides of jaws; the row on eyed side not so long as that on blind side. Gill rakers short and pointed; 4 or 5 on lower limb of arch. Origin of dorsal above anterior edge of upper eye or slightly posterior to edge. Pectoral of eyed side usually somewhat pointed at ends of upper rays; its length contained  $1\frac{4}{5}$  in head. Pectoral of blind side rounded, its length  $2\frac{3}{4}$  in head. Ventrals reaching to front of anal, that of blind side slightly the more anterior. Caudal truncate or very slightly convex.

A row of contiguous, rough plates between lateral line and outline of back, following the contour of the latter and running back to a little past middle of entire length. A shorter row of smaller plates, which are not in a contiguous row, but irregularly separated, is on lower part of side; its length considerably shorter than that of head. A row of narrow plates follows lateral line immediately above and below; the rows not at all continuous, but separated (sometimes



widely) at irregular intervals, and when separated the interval is filled by a dermal channel. One or two plates on base of pectoral and often one or two a short distance below and behind base. A few plates on each edge of caudal peduncle. Plates irregularly scattered over opercle and preopercle, an area just behind eyes, and sometimes on interorbital space, covered by thin skin, and apparently the roughened bones of the cranium. The skin otherwise smooth and naked.

Specimens up to 9 cm. in length are entirely smooth. In specimens from 10 to 12 cm. long the ridge running back from the interorbital space is becoming rough. Specimens from 14 to 16 cm. long have the row of rough plates on the back well developed, but not so conspicuous as in the adult; the row on lower part of sides and the rows along lateral line appearing. In one specimen 22 cm. long the ventral and lateral series have not developed. Apparently the last plates to appear are those on base of pectoral and on preopercle, though occasionally they are slightly developed in specimens 15 cm. long. All of the plates become more elevated and rougher with age.

Color uniform, brown or drab, often irregularly flecked with dark spots on the fins and body. These more conspicuous, and probably always present in the young. Usually a row of round white spots, set at rather wide intervals, follows the dorsal and ventral outlines of the body at a short distance from the base of the fins, and often other light spots are scattered irregularly over the body.

Specimens from Tokyo, Otaru, Aomori, Hakodate, Same, Matsushima, and Mororan, and the largest 27 cm. in length. The species is generally common in northern Japan and in northern China.

(*bis*, two; *coloratus*, colored.)

## 27. CLIDODERMA Bleeker.

*Clidoderma* BLEEKER, Comptes Rendus, Amsterd., XIII, 1862 (*asperrima*).

This genus is allied to *Pleuronectes*. Its principal character is the presence in the adult of many warty tubercles, the largest arranged in about 6 longitudinal rows. The very young are naked; the very old, almost evenly warty. The body is broader than in most related genera.

(κλείς, key; δέρμα, skin).

## 43. CLIDODERMA ASPERRIMUM (Schlegel).

*Platerra asperrima* SCHLEGEL, Fauna Japan, Paris, 1846, p. 172 (Nagasaki).

*Pleuronectes asperrimus* GÜNTHER, Cat. Fish, IV, 1862, p. 453 (copied)—NAMIYE.

Class. Cat., 1881, p. 110 (Tokyo).—OTAKI, Journ. Fish. Bur., 1897, p. 7, pl. VIII, fig. 8 (Tokyo).

*Clidoderma asperrimum* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 379 (Tokyo).—JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1904, p. 625 (Matsushima Bay).

*Habitat*.—Coasts of Japan, chiefly northward.

Head, 3 in length to base of caudal; depth,  $1\frac{1}{4}$ . Upper eye, 5 in head; maxillary,  $3\frac{2}{3}$ ; snout to upper eye,  $4\frac{1}{4}$ .

Gape nearly straight, curved down under tip of snout. Teeth bluntly pointed and irregular; in a single uneven row on eyed side of mandible, which is straight and higher than the curved, blind side of mandible, and shuts well past and within the premaxillary teeth of the eyed side; in 2 uneven rows on blind side of mandible, those of the outer row much the larger; in two rows on premaxillary of blind side similar to those of blind side of mandible; and in two very irregular rows on premaxillary of eyed side similar to the small inner row on blind side. Maxillary of eyed side reaching to opposite front of pupil; its length two-thirds of that of blind side, which reaches almost to posterior margin of eye and is contained  $2\frac{1}{3}$  times in head. Interor-

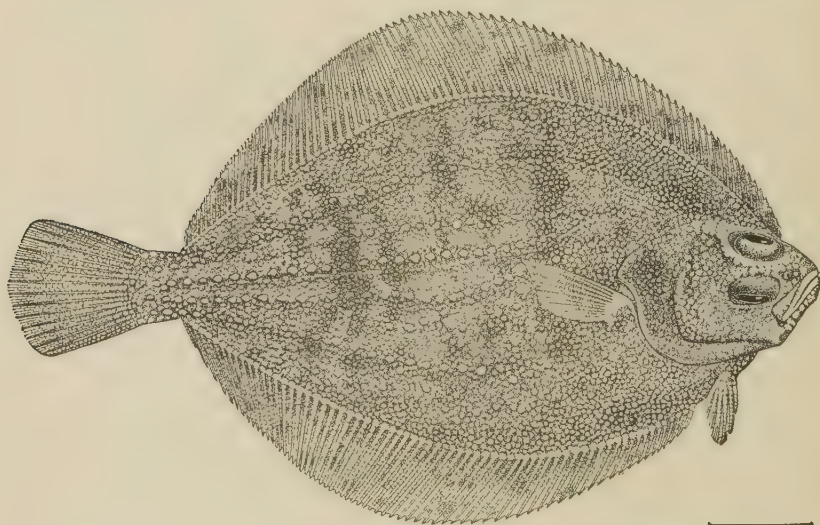


FIG. 20.—CLIDODERMA ASPERRIMUM.

bital space very narrow, but not sharp, continued back as a blind ridge behind upper eye. Gill rakers short, conical, and sharp, their number 4+10.

Origin of dorsal on blind side opposite front of eye and on a level with posterior nostril of blind side. Highest dorsal rays  $2\frac{3}{4}$  in head; a little shorter than highest anal rays. Pectorals broadly rounded; that of eyed side  $2\frac{1}{2}$  in head, that of blind side  $2\frac{1}{4}$ . Caudal rounded or double truncate. Body and everywhere on head, including snout, mandible, maxillary, and interorbital space, very rough with close-set bony plates. Larger plates, their tops more conical and extending above the others, are arranged in 5 or 6 rather definite longitudinal series. The bases of all the fins on eyed side and the surface of the eyeballs with fine, rough plates. Lateral line with a low curve ante-

riorly, but not angulated at posterior end of curve. Blind side of body with thin, smooth, naked skin.

Color dark brown with some indefinite blotches of darker.

Here described from a specimen 34 cm. in length from Mororan. We have specimens from Mororan, Hakodate, Aomori, Matsushima Bay, and Tokyo.

(*asperrimus*, very rough.)

## 28. MICROSTOMUS Gottsche.

*Microstomus* GOTTSCHÉ, Archiv für Naturgesch., 1835, p. 150 (*latidens*); not *Microstoma* RISSO, 1826.

*Cynoglossus* BONAPARTE, Fauna Italica, 1837, Pt. 19 (*cynoglossus* NILSSON, not of LINNÆUS).

*Cynoglossa* BONAPARTE, Catalogo Metodico Pesci Europei, 1846, p. 48 (*microcephalus*); not *Cynoglossus* HAMILTON, 1822.

*Brachyprosopon* BLEEKER, Comptes Rendus Acad. Sci. Amsterd., XIII, Pleuron., p. 7, 1862 (*microcephalus*).

Body elongate, compressed; mouth very small; teeth broad, incisor-like, on blind side only; scales small, all cycloid; vertebrae numerous (48 to 52); dorsal rays, 90 to 100; anal rays, 70 to 85; anal spine obsolete; left side of skull normal, without mucous cavities; ventral fins with 5 rays each. Arctic seas. This genus is widely separated from *Pleuronectes* and its allies by its greatly increased number of vertebrae, a character accompanied by a similar increase in the number of fin rays. It is close to *Glyptocephalus*, but the lack of the cavernous structure of the bones of the head, a structure peculiar to the species of that genus sufficiently distinguishes it.

(μικρός, small; στόμα, mouth.)

### KEY TO SPECIES.

- a. Body slender and fragile, the depth  $3\frac{1}{2}$  in length; dorsal rays about 93; anal 80; scales 90; color uniform ..... *kitaharæ*, 44
- aa. Body rather robust, the depth  $2\frac{1}{2}$  in length. Dorsal rays about 92; anal 76; scales 112; color brown, often blotched with rusty red..... *stelleri*, 45

## 44. MICROSTOMUS KITAHARÆ Jordan and Starks.

*Pleuronectes cynoglossus* ÔTAKI, Journ. Fish. Bur., 1897, p. 7, pl. vi, fig. 7 (Japan; not of LINNÆUS.)

*Microstomus kitaharæ* JORDAN and STARKS, Bull. U. S. Fish. Com., XXII, 1904, p. 625, pl. vii, fig. 2 (Matsushima Bay, Suruga Bay, Tsuruga, Japan Sea; Tokyo).

*Habitat*.—Coasts of northern Japan south to Tsuruga.

Head, 4.25 to 4.5 in length; depth, 3.5 to 3.75; D. 91 to 96; A. 75 to 83; scales, 87 to 96 (pores); eye, 2.83 to 3.16 in head; snout from upper eye, 4.33 to 4.75; maxillary, 3.75 to 4; pectoral of eyed side, 1.83 to 2.33, of blind side, 2.25 to 3; ventral, 3.5; caudal, 1.25.

Anterior upper profile evenly convex; the upper eye protruding above it; lower eye much in advance of upper, the eyes separated by



a very narrow ridge; maxillary short, rather strongly curved, reaching to below anterior edge of pupil of lower eye; teeth rather blunt, in a single row, forming a continuous even cutting edge; a small bony knob developed below tip of mandible; anterior nostril of eyed side in



FIG. 21.—*MICROSTOMUS KITAHARÆ*.

a short broad tube; gillrakers very short, 8 of them on lower limb of arch; scales everywhere cycloid, the snout, maxillary, and mandible naked; lateral line conspicuous, curving up just behind tip of pectoral above upper end of gill opening, but not at all arched; dorsal begin-



ning above posterior margin of pupil of upper eye; the longest dorsal and anal rays are at beginning of posterior fourth of body length; pectoral narrow, pointed, variable in length, the upper edge of its base distant one diameter of pupil from upper end of gill slit; ventrals reaching just to front of anal; caudal rounded or double truncate, the middle rays projecting beyond outer rays a distance slightly greater than half eye.

Color uniform brown, pectoral and caudal growing black toward tips of rays; no color on blind side except black toward end of caudal.

The type is 18 cm. in length, taken with several cotypes at station 3770, Matsushima Bay, in 42 to 45 fathoms. Other cotypes were taken near the same locality at stations 3769, 3771 (in 61 fathoms), and 3772 (in 79 fathoms); at station 3717, off Ose Point, Suruga Bay, in 65 to 125 fathoms, and station 3699, Suruga Bay, in 400 to 726 fathoms; others were collected by Jordan and Snyder in the market at Tokyo, several of which were deposited as cotypes in the Imperial University at Tokyo. Dried salted specimens were obtained in the market of Tsuruga.

*Type*.—Cat. No. 51418, U.S.N.M. Cotypes are Nos. 8390, 8995, 8996, Stanford University.

(Named for Mr. T. Kitahara, of the Imperial Bureau of Fisheries of Japan.)

#### 45. MICROSTOMUS STELLERI Schmidt.

##### BABAGAREI (OLD WOMAN FLOUNDER).

*Microstomus stelleri* SCHMIDT, *Pisc. Mar. Orient*, 1904, p. 247 (Mayka, Gensan, Shogun, Lake Askold, Shendogan, Gulf of Broughton, Gulf of Aneva.)

*Habitat*.—Northern Japan to Sakhalin and Korea.

Head,  $4\frac{1}{2}$  in length to base of caudal; depth,  $2\frac{1}{2}$ . Upper eye,  $4\frac{1}{3}$  in

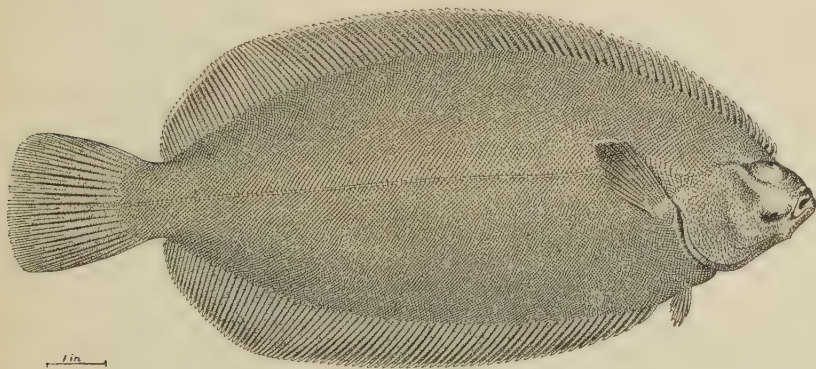


FIG. 22.—MICROSTOMUS STELLERI.

head; snout to upper eye,  $4\frac{2}{3}$ ; interorbital space,  $8\frac{1}{2}$ ; interorbital bone, 19; maxillary,  $4\frac{3}{4}$ ; dorsal, 92; anal, 76; pores in lateral line, 112.

Mouth small and curved, the maxillary reaching to below front of lower eye. Teeth on blind side of jaws, extending very slightly around

on colored side, especially on lower jaw; 12 to 14 teeth on mandible, 10 to 12 on premaxillary. They are strong and blunt in a single even row, forming a continuous cutting edge. Upper eye a little posterior to lower; interorbital space rather wide and convex, the bone narrow but not sharp, continued backwards and upwards on head behind eyes as a blunt, scaled ridge. Gillrakers short and pointed, 6+10 in number.

Origin of dorsal opposite middle of eye and slightly on blind side of body. Longest dorsal rays equal in length to those of anal and contained  $2\frac{2}{3}$  times in head. Pectoral usually rounded, its length  $1\frac{1}{2}$  in head; that of blind side 2. Caudal rounded, slightly angulated at ends of outer rays. Lateral line with a low arch anteriorly; length of arch contained  $5\frac{1}{3}$  in straight part of lateral line; its height  $\frac{1}{2}$  the long diameter of upper eye.

Color brown, indistinctly mottled with darker brown; some specimens show a dark blotch on lateral line at tip of pectoral, another just behind middle of straight part of lateral line, and very inconspicuous blotches at base of dorsal and anal fins. Blind side more or less spotted and soiled with dusky brown; the blind side of the vertical fins always dark. Both sides in life sometimes very much blotched with rusty red, sometimes without red.

Here described from a specimen 35 cm. in length from Hakodate.

It is rather common on the shores of Hokkaido. We have examples from Hakodate, Mororan, and the Ainu village of Edomo.

(Named for Dr. Georg Wilhelm Steller, naturalist of Bering's Expedition.)

## 29. GLYPTOCEPHALUS Gottsche.

*Glyptocephalus* GOTTSCHE, Archiv für Naturgesch., 1835, p. 156 (type *saxicola*=*cynoglossus* Linnaeus).

Eyes and color on the right side. Body extremely elongate, more than twice as long as deep, much compressed. Head very small and short, its blind side with many excavations and mucous cavities in the skull, mandible, and preopercle. Mouth very small; teeth moderate, incisor-like, broad, equal, close set, in a single series; no teeth on vomer or palatines. Gill rakers short, weak. Lower pharyngeals narrow, with 1 or 2 rows of conical teeth. Lateral line nearly straight, simple; scales very small, smooth; dorsal and anal very long, there being more than 90 rays in the dorsal and more than 80 in the anal; caudal fin rounded; anal spine present; ventral rays 6. Vertebrae in increased number, 58 to 65. Northern seas, in deep water. This genus is one of the most strongly marked in the family, being distinguished from most of the genera by the greatly increased number of vertebrae, and from all of them by the remarkable cavernous structure of the bones of the head. An undescribed species of this genus was seen by us in the museum at Hakodate. Our notes do not, however, justify the publication of the species.

(γλυπτός, sculptured; κεφαλή, head.)

## Family II. SOLEIDÆ.

## SOLES.

Body oblong or elongate, usually scaly; mouth very small, much twisted toward the eyed side; the teeth in villiform bands, very small or obsolete; eyes small, close together, with or without a bony ridge between them; edge of preopercle adnate, concealed by the skin and scales; gill openings narrow, the gill membranes adnate to the shoulder girdle above; pectoral fins small or wanting; ventral fins small, one or both sometimes wanting; small fishes, living on sandy bottoms, similar to the *Pleuronectidæ* in structure, but much degraded, the fins and teeth having lost many of their distinctive qualities. The vertebrae are usually in increased numbers. They are numerous in the warm seas, and those of sufficient size are valued as food. In Japan they are collectively known as Usinoshita (cow-tongue). The *Soleinæ* are quite unlike the *Cynoglossinæ*, and are perhaps independently derived from a flounder ancestry.

## KEY TO GENERA.

- a. Dorsal and anal free from caudal; eyes and color on the right side.
  - b. ACHIRINÆ.—Ventral fins unsymmetrical, that of the eyed side extending along ridge of abdomen, more or less united to the anal; vent to the left of median line; lateral line single.
  - c. Body broad-lanceolate; upper jaw prolonged in a long hook, surrounding lower jaw; scales cycloid; pectoral fins obsolete. . . . . *Amate*, 30
  - bb. SOLEINÆ.—Ventral fins nearly symmetrical, each with short base and free from anal; vent on median line; lateral line single; upper jaw moderately hooked.
  - d. Scales ctenoid; rays of dorsal and anal fins scaleless or nearly so; no pectoral fins. . . . . *Aseraggodes*, 31
  - dd. Scales cycloid; vertical fins scaleless; no pectoral fins; snout little hooked. . . . . *Liachirus*, 32
- aa. Dorsal and anal joined with the caudal.
  - e. SYNAPTURINÆ.—Eyes and color on the right side; ventrals free from anal; body broad.
    - f. Scales ctenoid; left pectoral rudimentary, reduced to a small flap; body with black crossbars . . . . . *Zebrias*, 33
    - ff. Scales cycloid; pectorals rudimentary; first dorsal ray prolonged; body cross-barred . . . . . *Æsopia*, 34
  - ee. CYNOGLOSSINÆ.—Eyes and color on the left side; eyes very small, close together; body lanceolate; no pectoral fins; scales ctenoid.
    - g. Lateral line present, on the left side.
      - h. Lips with tentacles or fringes; blind side without lateral line, a depression taking its place.
        - i. Left side with two lateral lines, right side with one . . . . *Paraplagusia*, 35
        - ii. Left side with three lateral lines, right side without lateral line. . *Usinosita*, 36
      - hh. Lips without fringes.
        - j. Lateral lines, two on the left side, one on the right. . . . . *Cynoglossus*, 37
        - jj. Lateral lines, three on the left side (two in young), one on the right . . . . . *Areliscus*, 38
    - gg. Lateral line wanting; ventral of eyed side only present, free from anal; lips without fringes . . . . . *Symphurus*, 39



## 30. AMATE Jordan and Starks.

*Amate* JORDAN and STARKS, new genus (*japonicus*).

This genus has the form and general proportions of *Solea*, but with the ventrals unsymmetrical as in *Achirus*, that of the eyed side having a prolonged base, extending along the ridge of the abdomen, its last ray united by membrane with the anal; vent to the left of the median line of the abdomen; body lanceolate; upper jaw forming a long hook, extending around the lower jaw. Scales ctenoid, vertical fins scaly. Lateral line single. This genus resembles the ordinary Soles, but its relations are with the American genus *Achirus*.

The type of the genus is the following species, *Amate japonica*.

(*amate*, or *yamate*, a Japanese name of *Limanda yokohamæ*, from *ame*, rain; or perhaps *ama*, a fisherman.)

## 46. AMATE JAPONICA (Schlegel).

*Achirus japonicus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 186 (Nagasaki).

*Solea japonica* GÜNTHER, Cat. Fish, IV, 1862, p. 471 (copied).

*Aseraggodes japonicus* JORDAN and SNYDER, Check List, 1901, p. 122 (Misaki).

? *Achirus hartzfeldii* BLEEKER, Amboina, III, p. 123 (Amboyna).

? *Solea hartzfeldii* GÜNTHER, Cat. Fish, IV, 1862, p. 471 (copied).

*Aseraggodes hartzfeldii* JORDAN and SNYDER, Check List, 1901, p. 122.

*Habitat.* Sandy bays of southern Japan, also in the East Indies, if *Amate hartzfeldii* is the same species.

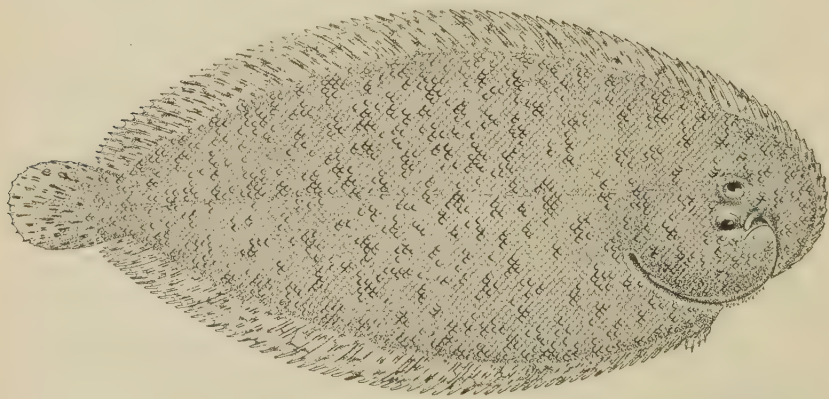


FIG. 23.—AMATE JAPONICA.

Head,  $3\frac{1}{5}$  in length to base of caudal; depth,  $2\frac{1}{3}$ . Upper eye, 8 in head. Dorsal, 84; anal, 55. Scales from opposite upper end of gill opening to base of caudal, 72; from upper eye to opposite gill opening, 18.

Hook of upper jaw extending around lower jaw usually to a point vertically opposite front of upper eye (somewhat anterior to this in the specimen figured). Fine teeth in bands on blind side of jaws. Middle of upper eye opposite front of lower. Interorbital space flat



or a little concave; its width equal to the vertical diameter of upper eye. Nostrils of eyed side close together, just in front of lower eye, and ending in tubes; the posterior tube short and broad, the anterior long and slender. Nostrils of blind side farther apart, the posterior one not ending in a tube, the anterior in a wide fleshy tube having a valve at its orifice and broadly fringed around its entire edge with tentacles; blind side of head with tentacles which are much larger toward the ventral edge.

Origin of dorsal on front of head just above tip of hook of upper jaw. Dorsal or anal not joined to caudal; ventral rather broadly united to front of anal; caudal rounded, not angulated at tips of outer rays. Scales everywhere ctenoid; the lateral line extending a short distance on head but not reaching to upper eye.

Color dark slate gray, marked with irregular, indefinite spots, more or less round, or forming obscure broken rings, the largest about twice the diameter of eye and composed of black on the posterior margins of scales in small groups. These are arranged more or less definitely; 3 or 4 on lateral line and several along body near base of dorsal and anal fins. The latter in small specimens interspaced with small white spots, slightly out of line with the black ones, and nearer the base of the fins. Other smaller spots are scattered over the head and body, and some specimens show slight traces of light vermiculations. All of the fins thickly spotted with small irregular spots of various sizes in sharp contrast with the nearly colorless surrounding areas.

Here described from specimens from Wakanoura, the largest 135 mm. in length. Other specimens from Tokyo, Tsuruga, Misaki, Kobe, and Nagasaki. It is common in sandy bays of southern Japan. (*japonicus*, Japanese.)

### 31. ASERAGGODES Kaup.

*Aseraggodes* <sup>a</sup> KAUP, Wiegmann's Archiv., 1858, p. 103 (*guttalatus*).

This genus is allied to *Solea* and other genera of European soles, differing from all these in the entire absence of pectoral fins. The ventral fins are nearly symmetrical, that of the eyed side being free from the anal. Vent nearly on the median line of abdomen. Scales ctenoid; eyes and color on the right side; dorsal and anal free from caudal. Small fragile soles of the East Indian region, the fin rays fewer, the snout less hooked than in the genus *Amate*. Rays of dorsal and anal scaleless or nearly so.

( $\alpha$ , without; *σηραγγώδης*, full of pores.)

<sup>a</sup> This genus is thus defined by Kaup: "Achiren ohne Poren au den verticalen Flossen. Caudal rund und bestimmt getrennt. Mehr oblonger form." (*Guttrulatus*, *poropterus*, and *hartzfeldi*.)

## 47. ASERAGGODES KOBENSIS (Steindachner).

*Solea (Achirus) kobensis* STEINDACHNER, Reise Aurora, 1896, p. 218 (Kobe).

*Aseraggodes kobensis* JORDAN and SNYDER, Check List, 1901, p. 122.

*Habitat*.—Sandy shores of southern Japan.

Head,  $4\frac{1}{2}$  to base of caudal; depth,  $2\frac{2}{5}$ . Eye, 6 in head; snout (to upper eye),  $3\frac{1}{3}$ ; depth of caudal peduncle, 2. Dorsal, 70; anal, 51. Scales, counting from opposite gill opening to caudal, 61; from opposite upper eye, 76; in a transverse oblique series near middle of body,  $24 + 1 + 26$ .

Snout but little hooked; the tip of the hook slightly in advance of tip of the mandible and on a level with lower margin of lower eye. Gape ending opposite front of pupil of lower eye. Fine teeth in rather broad bands on blind side of jaws, 3 or 4 teeth in a single row on front of premaxillary of eyed side. Interorbital space concave; its width equal to length of pupil. Middle of upper eye directly over

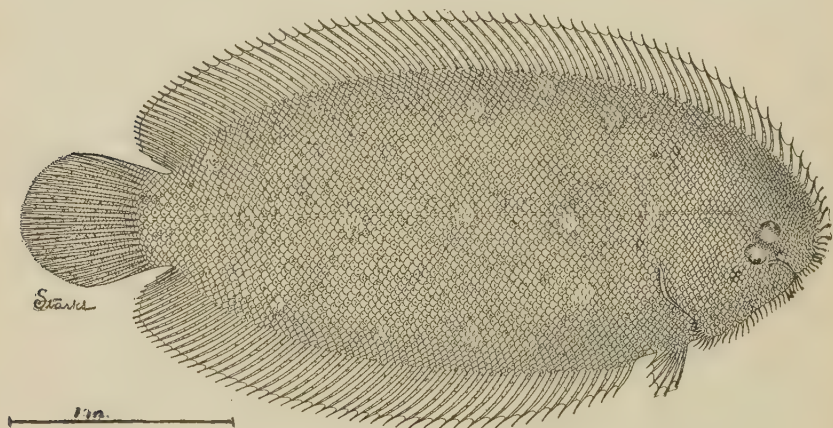


FIG. 24.—ASERAGGODES KOBENSIS.

front of lower eye. Anterior nostril of colored side ending in a wide tube above the middle and close to the edge of mouth; that of blind side higher, the tube slightly longer. Posterior nostril of eyed side under front of lower eye and with a thin flap at its anterior margin. Length of gill opening 2 in head.

Origin of dorsal on front of head on a level with middle of upper eye. Longest dorsal rays equal to length of longest anal rays and contained  $1\frac{1}{2}$  in head. Ventral of eyed side not joined to anal, its tip just reaching to first anal ray. Caudal fin rounded and with no angles at tips of outer rays; its length one diameter of eye shorter than head. Lateral line straight and simple, extending a short distance on head, but not reaching to upper eye. Scales everywhere ctenoid except on anterior part of blind side of head.

Color grayish brown, with 3 or 4 irregular and indefinite dark spots or sometimes rings on lateral line. Small dark points scattered over

the body, with slightly larger ones spaced near the base of dorsal and anal fins and interspaced with bluish white spots. Many specimens from Nagasaki from 7 to 9 cm. in length. It is rather common in sandy bays of southern Japan.

(*Kobensis*, from Kobe.)

### 32. LIACHIRUS Günther.

*Liachirus* GÜNTHER, Cat. Fish, IV, 1862, p. 479 (*nitidus*).

Eyes and color on the right side, mouth narrow, more developed on the blind side; teeth minute, on the blind side only. Dorsal and anal rays scaleless, without pores at base; dorsal beginning on the snout; caudal free from dorsal and anal; no pectorals; ventrals both developed, free from anal. Scales small, cycloid. Lateral line straight; an accessory lateral line on blind side, from snout along upper profile of nape. Gill openings narrow, the membranes broadly united. One species known, differing from *Aseraggodes* mainly in the cycloid scales.

(*λεῖος*, smooth, *Achirus*.)

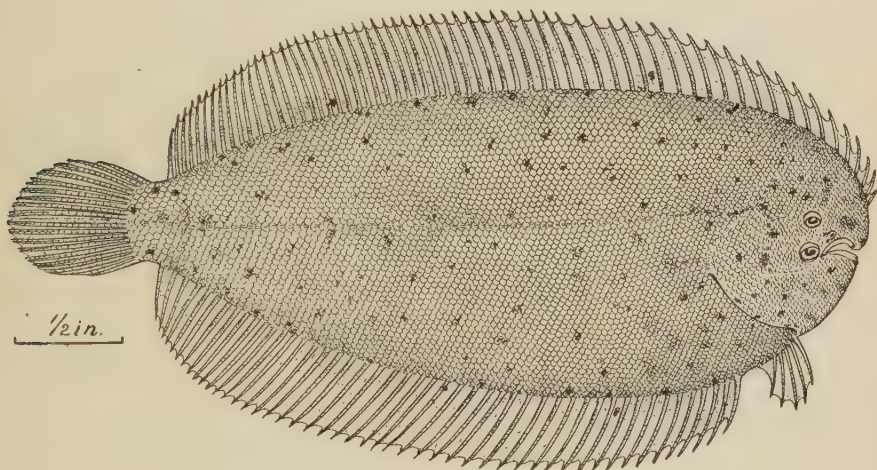


FIG. 25.—*LIACHIRUS NITIDUS*.

### 48. LIACHIRUS NITIDUS Günther.

*Liachirus nitidus* GÜNTHER, Cat. Fish, IV, 1862, p. 479 (China).—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 366 (Giran, Formosa).

*Habitat*.—Coast of China, north to Formosa and Kiusiu.

Head,  $4\frac{1}{2}$  in length to base of caudal; depth,  $2\frac{1}{2}$ . Snout,  $3\frac{1}{2}$  in head. Dorsal, 63; anal, 48; ventral, 5. Scales, 25–92–35. Body dextral, oblong elliptical; snout bluntly rounded. Mouth rather large, the gape reaching eyes. Eyes close together, small. Scales very small, smooth and rather loosely attached; lateral line extending from near upper eye nearly straight to middle of caudal. Dorsal and anal fins rather high, the longest rays  $1\frac{1}{2}$  in head.



Color yellowish gray, the body and head sparsely covered with small, roundish, black spots, a few of these upon dorsal and anal fins. Dorsal and anal rays black edged; caudal with a few dark specks.

One specimen was taken by Dr. Hugh M. Smith at Suzaki in Shikoku, province of Tosa, and at Yamagawa, in Kagoshima Bay, the above account from a specimen 4 inches long from Giran, Formosa.

(*nitidus*, shining.)

### 33. ZEBRIAS Jordan and Snyder.

*Æsopia* KAUP, Weigmanns Archiv., 1858, p. 95 (*zebra*, *cornuta*, etc.).

*Zebrias* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380 (*zebrinus*).

Allied to *Synaptura*, differing in having the pectoral fin of the left side rudimentary or wanting. Body with black cross bars, more or less arranged in pairs. Body broad-ovate; dorsal and anal united with the caudal. Eyes and color on the right side. Eyes rather small, the upper in advance of lower. Mouth small, twisted to the left side; teeth minute, on blind side only. Scales small, ctenoid. Lateral line single, straight. In our judgment, the name *Æsopia* should replace *Zebrias*, for this genus.

(*zebra*, *zebra*.)

#### KEY TO SPECIES.

- a. Caudal with yellow spots; dorsal and anal fully united to caudal.....*zebrinus*, 49  
 aa. Caudal without yellow spots; dorsal and anal not fully united to caudal .....*japonicus*, 50

### 49. ZEBRIAS ZEBRINUS (Schlegel).

SHIMA-USINOSHITA (STRIPED COW-TONGUE); SHIMAGAREI (STRIPED FLOUNDER).

*Solea zebrina* SCHLEGEL, Fauna Japonica, 1846; p. 186, pl. xcv, fig. 1 (Nagasaki).

*Zebrias zebrinus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 900 (Nagasaki); Check List, 1901, p. 123 (Nagasaki).

*Solea ommatura* RICHARDSON, Ichth. China, 1846, p. 279 (Canton).

*Synaptura ommatura* REGAN, Ann. Mag. Nat. Hist. (7), XI, 1903, p. 56 (southern Japan).

*Pleuronectes fasciatus* GRONOW, Syst., Ed. Gray, 1854, p. 91.

*Synaptura zebra* GÜNTHER, Cat. Fish, IV, 1862, p. 484 (Amoy, Pinang).—NAMIYE, Class. Cat., 1881, p. 111 (Tokyo).—OTAKI, Journ. Fish. Bur., 1897, p. 8, pl. VIII, fig. 11.—ISHIKAWA, Prel. Cat., 1897, p. 24 (Tokyo).

*Brachirus zebra* BLEEKER, Atlas Pleur., 1870, pl. IX, fig. 3 (East Indies); Poiss. Conn. Japoni, 1870, p. 22 (Nagasaki, Shimoda).

(Not *Pleuronectes zebra* BLOCH, Ausl. Fische, III, 1790, p. 27, pl. CLXXXVII=*Synaptura zebra* DAY, Fishes India=*Æsopia quagga* KAUP, Wieg. Archiv., 1858, p. 98.)

*Zebrias zebra* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 769 (Yokohama).—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 367 (Formosa, not of BLOCH).

*Habitat*.—Coasts of Japan, north to Hakodate, south to Formosa.



Head,  $5\frac{1}{2}$  to  $5\frac{3}{4}$  in length to base of caudal; depth,  $2\frac{1}{2}$  to  $2\frac{2}{3}$ . Upper eye,  $6\frac{1}{2}$  to  $7\frac{1}{2}$  in head. Dorsal, 72 to 76; anal, 63 to 66. Scales from opposite gill opening to caudal, 89 to 96; 15 or 16 on head between upper eye and gill opening.

Mouth terminal and curved, but the tip of upper jaw scarcely hooked. Small teeth in bands on blind side of jaws. Eyes separated by a narrow, scaly interorbital space, less than half the diameter of upper eye. Anterior fourth to two-fifths of upper eye above front of lower eye.

Upper 3 or 4 rays of pectoral of eyed side produced but not abruptly, the lower outline concave and the length of the rays from the first to the last graduated, its length of the produced rays variable, from  $1\frac{1}{4}$  to  $2\frac{1}{4}$  in head. Ventrals nearly symmetrical and well separated from the anal. Last rays of dorsal and anal reaching to tips of caudal rays, so that the outline is continuous around the caudal.

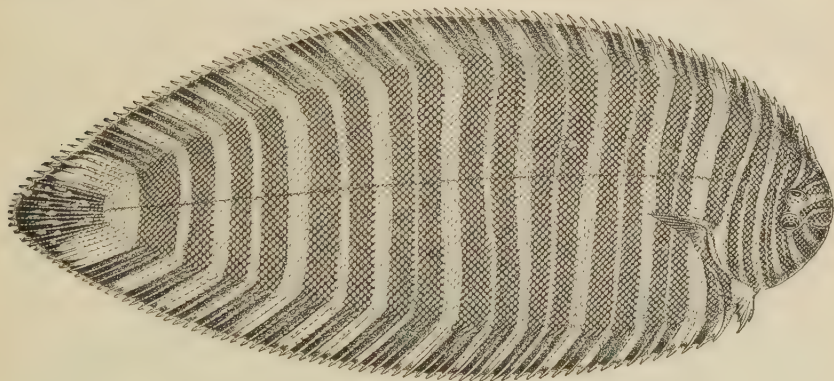


FIG. 26.—*ZEBRIAS ZEBRINUS*.

Length of last dorsal ray  $1\frac{1}{2}$  in head, equal in length to that of anal. Caudal rounded narrowly; its length nine-tenths of that of head. Scales everywhere ctenoid. Pores of lateral line equal in number to series of scales; the lateral line extends onto the head over 6 or 7 scales.

Head and body light gray crossed with black bars more or less definitely arranged in pairs. These may be uniform black or a little lighter in the middle, but never conspicuously lighter as in *Z. japonicus*. A bar across gill opening, involving base of pectoral, its posterior edge just behind base of pectoral. Behind this are 8 pairs of bars, the posterior one of the last pair much the widest, its posterior edge just at or somewhat anterior to base of caudal. Base of caudal rays of the gray body color; the greater part of the caudal, including the tips of the dorsal and anal rays, marked with a large round dead black spot two-thirds of the length of the head in diameter and bearing several milk-white, clear-cut oblong spots of irregular size, often

arranged as an obscure ring. Two small specimens have the white spots fewer, larger, and not so sharp cut. The bars of the body extend to the edges of the dorsal and anal fins, running longitudinally with the rays. Posteriorly the dorsal, anal, and caudal are narrowly edged with white. Vertical fins of the blind side uniform black, edged with white, growing light toward base of rays. Pectoral black.

Many specimens from 12 to 24 cm. in length collected at Nagasaki, Tokyo, Kobe, and Hakata. The species is common in southern Japan, where it reaches a considerable size. It is valued as a food fish.

(*zebrinus*, zebra-like.)

#### 50. ZEBRIAS JAPONICUS (Bleeker).

*Esopia japonica* BLEEKER, Japan, VI, 1869, p. 71 (Nagasaki; (young).

*Synaptura japonica* GÜNTHER, Cat. Fish, IV, 1862, p. 485 (copied.)

*Brachirus japonicus* BLEEKER, Enum. Poiss., Conn. Jap., 1879, p. 22 (Nagasaki).

*Synaptura smithi* REGAN, Ann. Mag. Nat. Hist., 1903, p. 57, pl. vi (Inland Sea of Japan).

*Habitat*.—Shores of southern Japan, north to Tokyo.

Head,  $5\frac{1}{2}$  to  $5\frac{3}{4}$  in length to base of caudal; depth,  $2\frac{1}{2}$  to  $2\frac{3}{4}$ . Upper eye, 5 to  $5\frac{1}{2}$  in head. Dorsal, 73 to 79; anal, 59 to 64. Scales from opposite gill opening to caudal, 80 to 98; 15 or 16 from upper eye to gill opening.

This species differs from *Z. zebrinus* in having the eyes larger. In some specimens the upper eye is scarcely in advance of lower, in others the anterior third of upper eye overhangs the front margin of the lower, and in others the upper eye varies between these extremes. Upper 2 pectoral rays abruptly produced beyond the short lower ones; not so long as in *Z. zebrinus*, 2 to  $2\frac{1}{2}$  in head. Last rays of dorsal and anal attached to base of caudal, leaving the latter distinct and the outline of fins not continuous around caudal, as in *Z. zebrinus*. The papillæ on the blind side of head are much more numerous.

The cross bars on body not so dark or not so uniform in color as in *Z. zebrinus*; the middle of each bar always much lighter than the edges, often so light as to subdivide some of the bars. A light interspace is across the gill opening, and instead of the posterior edge of a dark bar being just behind the pectoral as in *Z. zebrinus*, the anterior edge of a bar is in this place. Behind the pectoral are 8 or 9 pairs of dark bars, the last bar crossing the base of the caudal, about half of it being on the caudal rays; behind this is a gray or white bar, and the posterior third of the fin is abruptly black. Pectoral light or dusky. The species otherwise as *Z. zebrinus*. The attachment of the dorsal and anal to the caudal is not variable in our specimens as described by Regan.

Specimens from Tokyo and Wakanoura, from 100 to 165 mm. in length. Southern Japan, rather rare.

(*japonicus*, Japanese.)

34. *ÆSOPIA* Kaup.

*Æsopia* KAUP, Wiegmanns Archiv., 1858, p. 95. (*Cornuta*, as restricted by GÜNTHER, Cat. Fish, IV, p. 487.)

Scales cycloid, smooth; first dorsal ray prolonged; pectorals rudimentary. Otherwise as in *Zebrias*. As originally constructed, *Æsopia* was equivalent to *Zebrias*, but *Æ. cornuta* was included among the species, originally renumerated by Kaup, and the name *Æsopia* was restricted to that species by Günther. Nevertheless we think that the name *Æsopia* should be used for the genus here called *Zebrias*. In that case, *cornuta* should receive a new generic name.

(Æsop, the author of classic fables, in allusion to the slave costume of many stripes, worn by Æsop, and by these fishes.)

51. *ÆSOPIA CORNUTA* Kaup.

*Jerree potoo* RUSSELL, Fish Coromandel, 1803, pl. LXXII (Vizagapatam, "La Sole Cornue").—CUVIÉR, Règne Animal, 2d ed., 1828; after Russell.

*Æsopia cornuta* KAUP, Wieg. Archiv., 1858, p. 95 (British India).—GÜNTHER, Cat. Fish, IV, 1862, p. 487 (copied).—DAY, Proc. Zool. Soc., 1873, p. 238 (India); Fishes India, p. 438, pl. xciv, fig. 4 (Coromandel).

*Synaptura potoo* BLEEKER, Bengal en Hindustan, p. 76, after Russell.

*Habitat*.—India, north to Nagasaki.

Head,  $4\frac{3}{4}$  in length to base of caudal; depth, 3. Eye,  $5\frac{1}{2}$  in head.

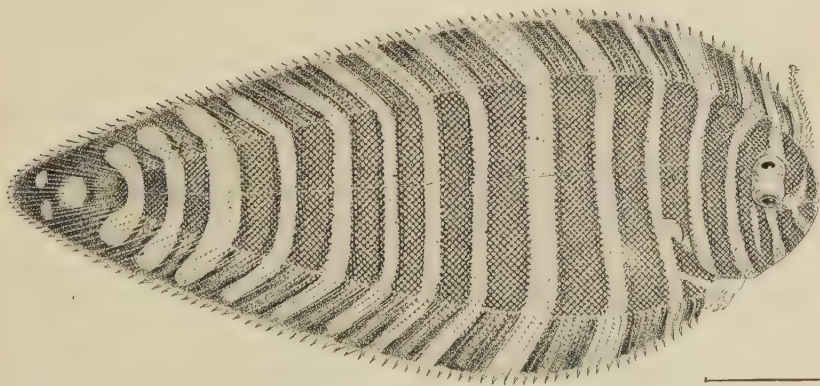


Fig. 27.—*ÆSOPIA CORNUTA*

Dorsal 79; anal, 66. Scales from opposite gill opening to caudal, 94; from upper eye to gill opening, 19.

Jaws even in front, the gape extending back to below front edge of pupil of lower eye. Teeth very small, in bands on blind side of jaws. Eye contiguous, the upper very slightly in advance of lower. Anterior nostril of colored side in a large tube, much longer and wider than its mate of the opposite side.

First ray of dorsal swollen, produced, and covered with small tentacles or villæ. It is situated vertically above anterior nostril and its



length is contained  $1\frac{1}{2}$  times in head. The dorsal and anal are attached to the entire length of the outer caudal rays, so that the outline around them is unbroken. Ventrals symmetrical and well separated from anal. Pectorals of both sides rudimentary, represented by a short flap broader than long in which the rays are evident. Lateral line straight, continued on head over 11 or 12 scales, not reaching to upper eye. Scales everywhere cycloid.

Color grayish brown crossed with wide, dark-brown bands, rather lighter in the middle, and extending to the tips of the dorsal and anal rays. Four bands on head, the one at posterior part of eye divided into 2; one across rudimentary pectoral and gill opening, behind which are 11 bands, counting a small spot at base of caudal rays; caudal and distal half of posterior dorsal and anal rays black; a round opaque white spot at middle of caudal. Dorsal and anal rays opposite the light bars on body are opaque white and sometimes a suggestion of the same color opposite the middle of the dark bars. Dorsal, anal, and caudal uniform dark on blind side growing light toward base.

Here described from a single specimen 125 mm. long from Nagasaki. It has not otherwise been recorded except from India.

(*cornutus*, horned.)

### 35. PARAPLAGUSIA Bleeker.

*Plagusia* (Brown) CUVIÉR, Regne Animal, II, 1817, p. 224 (*bilineata*, etc.) (not

*Plagusia* LATREILLE, 1806, a genus of Crustacea).

*Paraplagusia* BLEEKER, Atlas Pleuron., 1870, p. 26 (*bilineata*).

? *Rhinaplagusia* BLEEKER, Atlas Pleuron., 1870, p. 26.

Left side with two lateral lines, right side with one. Otherwise as in *Usinosita*.

(*παρά*, near; *Plagusia*.)

### 52. PARAPLAGUSIA DIPTERYGIA (Rüppell).

*Plagusia dipterygia* RÜPPELL, Atlas Fische, 1828, p. 123, pl. xxxi, fig. 3 (Red Sea).

*Plagusia marmorata* BLEEKER, Verh. Bat. Gen., XXIV, Pleuron, p. 20 (Amboyna);

Nederl. Tydsch, I, p. 411.—GÜNTHER, Cat. Fish, IV, 1862, p. 491 (Amboyna).—BLEEKER, Enum. Poiss. Conn. Japon (Kiusiu).

*Paraplagusia marmorata* BLEEKER, Enum. Poiss. Connus Japon, 1879, p. 22.

(No locality specified, probably Riu Kiu Islands).

*Habitat*.—East Indies, doubtfully recorded from Japan.

Head, two-ninths of total length; depth, over one-fourth. Dorsal, 99 to 106; anal, 75 to 85. Lateral line, 100.

Two lateral lines on left side separated by 17 longitudinal series of scales at the point of their greatest distance. Length of snout two-fifths of that of head. Rostral hook very long, extending far behind lower eye. Color brownish finely marbled with dark brown. (Günther.)

Not seen by us.

(*δίς*, two; *πτερυξ*, fin.)



## 36. USINOSITA Jordan and Snyder.

*Usinostia* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380. (*japonica*.)

*Usinosta* JORDAN and SNYDER, Check List, 1901, p. 123. (*japonica*.) (*Usinostia* and *Usinosta* both accidental misprints for *Usinosita*.)

*Usinosita* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 366. (*japonica*.)

Eyes and color on the left side; no pectoral fins; dorsal and anal united around the tail; ventral of the blind side absent, that of eyed side so connected to anal as to be scarcely distinguished from it; scales ctenoid, small; lateral lines 3 on the left side, a rudimentary one on the right without pores; upper jaw ending in a hook, surrounding the lower jaw; lip of colored side with tentacles; teeth minute on blind side only. One nostril, on the left side, before angle of lower orbit. Gill opening very narrow; body lanceolate.

(*usinoshita*, the Japanese name; *usi*, cow; *shita*, tongue in Japanese; *no*, is the mark of the genitive case.)

## 53. USINOSITA JAPONICA (Schlegel).

USINOSHITA (COW-TONGUE); SHITA-BIRAME (TONGUE-FLOUNDER); AOSHITABIRAME (BLUE TONGUE-FISH).

?? *Pleuronectes japonicus*<sup>a</sup> HOUTTUYN, Holl. Mats. Weet. Haarlem, 1782, p. 311 (Nagasaki.)

*Plagusia japonica* SCHLEGEL, Fauna Jap. Poiss., 1846, p. 187, pl. xcv, fig. 2 (Nagasaki).—BLEEKER, Act. Soc. Sci. Ind. Nederl. Japan, IV, p. 26 (Nagasaki). GÜNTHER, Cat. Fish, IV, 1862, p. 492 (copied).—NAMIYE, Class. Cat., 1881, p. 111 (Tokyo).—OTAKI, Journ. Fish. Bur., 1896, p. 8.—ISHIKAWA, Prel. Cat., 1896, p. 24 (Tokyo).

*Usinostia japonica* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380 (Tokyo).

*Usinosta japonica* JORDAN and SNYDER, Check List, 1901, p. 123 (Nagasaki, Shimoda).

*Usinosita japonica* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 366 (Keerun).—JORDAN and STARKS, Bull. U. S. Fish Com., 1904, p. 628 (Suruga Bay).

*Habitat*.—Coasts of Japan and Formosa, north to Aomori.

Head,  $4\frac{1}{3}$  to  $4\frac{1}{2}$  in length to base of caudal; depth,  $3\frac{1}{4}$  to  $3\frac{1}{2}$ . Eye, 12 to 14 in head; interorbital space, 13 to 14; distance from front of head longitudinally to upper eye,  $2\frac{1}{3}$ . Dorsal, 104 to 110; anal, 83 to 86. Scales, from opposite gill opening, 92 to 96.

Hook of upper jaw very long, extending around lower jaw to opposite vertical from posterior margin of lower eye, or often considerably

<sup>a</sup> Form of the European sole. Eyes on the left side. P. 9; V. 5; C. 16. Dorsal and anal rays not counted, for the large numbers. Body 6 inches long, somewhat round on the dorsal side, white below. (Houttuyn.) The enumeration of pectoral rays prevents us from identifying Houttuyn's description with this species. The only soles in Japan with pectoral fins have the eyes on the right side.

past. Teeth in bands on blind side of jaws. Lips of eyed side with long, fringed tentacles, larger on lower lip; anterior nostrils in tubes. Interorbital space flat or slightly concave, covered with scales, in large specimens (28 cm. long)  $1\frac{1}{3}$  times long diameter of upper eye; equal to diameter of eye in smaller specimens (20 cm. long). Relative position of eyes somewhat variable, in some specimens the anterior two-thirds of upper eye is in front of the vertical from anterior edge of lower eye, in others the upper eye varies from this point until its posterior edge is vertical from anterior edge of lower eye.

Outline of dorsal, anal, and caudal continuous around tail, the caudal not differentiated by a notch at last rays of dorsal and anal. Ventral 4 rayed, and scarcely differentiated from anal; ventral of blind side absent. Scales ctenoid on eyed side, cycloid on blind side. A slight depression on blind side along middle of body suggests a lateral line but it is without pores; 3 lines on blind side of body, one median, and one following each the dorsal and anal outline of body.

Color uniform brown usually with irregular dark specks scattered irregularly and sparsely over the body; fins uniform darker brown with pale margins, similar but darker on blind side.

Here described from specimens from 20 to 28 cm. in length from Wakanoura, Kobe, and Tokyo. It is a common market fish of southern Japan.

(*japonicus*, Japanese.)

### 37. CYNOGLOSSUS Buchanan-Hamilton.

*Cynoglossus* BUCHANAN-HAMILTON, Fishes of the Ganges, 1822, p. 32. (*lingua*.)

Body lanceolate, covered with ctenoid scales; two lateral lines on the left side, one rudimentary on the right as in *Usinosita*; Eyes and color on the left side; snout produced into a hook; mouth narrow, the lips not fringed; two nostrils on the left side, one of them between the eyes. Gill opening very narrow.

East Indian Seas: The genus is here restricted by the separation of the species with two lateral lines on each side (*Arelia*), of those with three lateral lines (*Areliscus*), of those with peculiar nostrils (*Can-toria*), of those with one nostril (*Trulla*), and of those with none (*Icania*).

(κῦων, dog; γλῶσσα, tongue.)

#### KEY TO SPECIES.

- a. Eye about 12 in head. D. 125, A. 98. Scales about 70; about 10 series of scales between lateral lines ..... *robustus*, 54  
 aa. Eye  $7\frac{1}{2}$  in head. D. 129, A. 104. Scales 74. Nine rows of scales between lateral lines ..... *brunneus*, 55

54. *CYNOGLOSSUS ROBUSTUS* Günther.

*Cynoglossus robustus* GÜNTHER, Ann. Mag. Nat. Hist., 1873, p. 243 (Shanghai).  
(D. 130. Scales 83.)—STEINDACHNER, Reise Aurora, 1896, p. 219 (Kobe).—  
JORDAN and SNYDER, Check List, 1901, p. 123.

*Habitat*.—Coasts of Japan and North China, north to Tokyo.

Head, from  $4\frac{3}{4}$  to 5 to base of caudal; depth,  $3\frac{3}{4}$  to  $3\frac{1}{2}$ . Upper eye,  $12\frac{1}{2}$  to  $13\frac{1}{2}$  in head. Dorsal, 122 to 127; anal, 96 to 100. Scales from opposite gill opening, 69 to 71.

Upper jaw moderately hooked, the point of hook reaching to below anterior nostril, or a little anterior to this point. Lips not fringed; fine teeth in bands on blind side of both jaws. Anterior nostril of eyed side in a tube, the posterior nostril wider, without a tube, its position on interorbital space just behind front of eyes. Both nostrils of blind side in short tubes, the posterior are much the wider. Upper eye slightly in advance of lower; interorbital space slightly concave, covered with scales, its width equal to vertical diameter of upper eye.

Ventral 4 rayed, broadly joined to the anal; its rays closer together than the anal rays, and its distance from anal somewhat greater than distance between anal rays. Outline of dorsal and anal unbroken around caudal. Scales ctenoid on posterior part of eyed side of body; cycloid on anterior part and on blind side. Ten scales between lateral lines at middle of body; 76 to 79 longitudinal series of scales, counting from the line of pores connecting upper and lower lateral lines (as counted by Steindachner).

Color uniform light brown; the fins darker brown, growing light at edges; fins on blind side colorless.

We have specimens of this species from Tokyo, Kobe, Onomichi, and Nagasaki; the largest 36 cm. in length.

It is the largest and most abundant of the Tongue-fishes in Japan, next to *Urosalpinx japonica*. It is valued as a food-fish. It is somewhat doubtful whether the Japanese species is identical with the Chinese form called *robustus*.

(*robustus*, strong.)

55. *CYNOGLOSSUS BRUNNEUS* Regan.

*Cynoglossus brunneus* REGAN, Ann. Mag. Nat. Hist., 1905, p. 26 (Inland Sea of Japan).

*Habitat*.—Coasts of southern Japan.

Head,  $4\frac{2}{3}$  in length; depth, 4. Eye,  $7\frac{1}{2}$  in head; snout,  $2\frac{3}{5}$ . Dorsal, 129; anal, 104; scales, 74.

Interorbital width 3 times in eye. Two nostrils on eyed side, one between anterior parts of eyes, the other in front of lower eye. Maxillary extending to below posterior margin of eye; rostral hook extending to below mandibular symphysis. Two lateral lines on

eyed side with 9 rows of scales between them. Color, uniform brownish. Length 200 mm. (Regan.) Inland Sea of Japan.

This species differs from *Cynoglossus robustus* particularly in having a larger eye. We have seen no specimens.

(*brunneus*, brown.)

### 38. ARELISCUS Jordan and Snyder.

*Areliscus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380. (*joyneri*.)

This genus differs from *Cynoglossus* in the presence of three lateral lines on the left or eyed side of the body. The third or lowest of these is often obsolete in the young. The genus is therefore little different from *Cynoglossus*.

(*Arel*, an Indian name of *Arelia arel*.)

#### KEY TO SPECIES.

- a. Scales moderate, less than 100 in lateral line.
- b. Dorsal rays, 104; anal, 83; scales 70. Eye, 7 in head; lower lateral line obsolete in young, the upper more or less interrupted ..... *interruptus*, 56
- bb. Dorsal rays, 110; anal, 85; scales, 75. Eye, 15 in head; lower lateral line well developed ..... *joyneri*, 57
- aa. Scales, very small, 120 to 150 in lateral line.
- c. Dorsal rays, 128; anal, 104; scales, 120. Eye, 8 in head... *purpureomaculatus*, 58
- cc. Dorsal rays, 123; anal rays, 95; scales, 145. Eyes very small..... *semilævis*, 59

### 56. ARELISCUS INTERRUPTUS (Günther).

#### GENCHO (ORIGINAL ONE).

*Cynoglossus interruptus* GÜNTHER, Shore Fishes Challenger, 1880, p. 70, pl. xxx, fig. B (Yokohama, Swatow).—STEINDACHNER, Reise Aurora, 1896, p. 220 (Kobe, Hiogo, Nagasaki).—OTAKI, Journ. Fish. Bur., 1897, p. 8.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380 (Tokyo); Check List, 1901, p. 123 (Yokohama).

Head,  $5\frac{1}{5}$  to  $5\frac{1}{3}$  in length to base of caudal; depth,  $3\frac{1}{2}$  to  $3\frac{3}{4}$ . Upper eye, 7 to  $7\frac{1}{2}$  in head. Dorsal, 102 to 106; anal, 80 to 85. Scales from opposite gill opening to caudal base 65 to 70; from upper posterior edge of opercle 5 or 6 more.

Eyes very close together, but with an evident septum; anterior edge of pupil opposite anterior edge of lower eye. End of maxillary under posterior edge of pupil of lower eye. Anterior nostril in a tube in front of lower eye; posterior nostril rather small, without a tube and placed between front of eyes.

Ventral joined to anal. Scales everywhere ctenoid except on anterior part of blind side of head. Three lateral lines usually present, the upper and lower ones not so well developed as in the genus *Usinosita*. Frequently the lower one is broken at irregular intervals, and often, especially in the smaller examples, it is entirely absent, in



which case the upper one is confined to the anterior part of the body as described by Günther for the type.

Head and body uniform dusky brown; the fins darker and slightly mottled, growing lighter toward the tips of the rays; fins dusky on blind side.

Of this species we have specimens from Tokyo, Nagasaki, Wakanoura, Matsushima, Onomichi, and Hiroshima. The largest 17 cm. in length.

It is generally common in the markets of Japan, reaching a smaller size than *Cynoglossus robustus*.

(*interruptus*, interrupted, in allusion to the broken upper lateral line.)

#### 57. ARELISCUS JOYNERI (Günther).

*Cynoglossus joyneri* GÜNTHER, Ann. Mag. Nat. Hist., 1878, p. 486 (Tokyo); Shore Fish Challenger, p. 70, pl. xxx, fig. A (Tokyo).—OTAKI, Journ. Fish. Bur., 1896, p. 9, pl. VIII, fig. 12.

*Areliscus joyneri* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 380 (Tokyo); Check List, 1901, p. 123 (Yokohama).

*Habitat*.—Coasts of Southern Japan, north to Tokyo.

Head,  $4\frac{2}{3}$  to  $4\frac{1}{2}$  in length to base of caudal; depth,  $3\frac{3}{5}$  to  $3\frac{1}{2}$ . Eye, 15 or 16 in head. Dorsal, 106 to 112; anal, 83 to 86. Scales, from opposite gill opening, 70 to 75; from upper end of opercle, 5 or 6 more.

Eyes small, separated by a flat or slightly concave space, covered with scales, and equal in width to vertical diameter of eye; middle of upper eye over front margin of lower. Rostral hook reaching around mandible to a point vertical from front of upper eye or sometimes a little anterior to that point. Lips not fringed; teeth rather coarse, in bands on blind side of jaws. Anterior nostril of eyed side in a tube, in front of, and on a level with lower edge of lower eye; posterior nostril ending at surface of skin between front of eyes opposite middle of interorbital space.

Ventral connected with anal by membrane. Scales everywhere cycloid on eyed side except posteriorly where a few scales are ctenoid, the spinules rather few on each scales, some scales with only one. Lateral lines three, separated at the middle of body by 12 series of scales.

Color uniform brownish, the fins darker, but growing white at the edges; fins on blind side colorless.

Of this species we have several specimens from Tokyo, the largest 225 mm. long.

(Named for Mr. Joyner, its discoverer.)

## 58. ARELISCUS PURPUREOMACULATUS (Regan).

*Cynoglossus purpureomaculatus* REGAN, Ann. Mag. Nat. Hist., 1905, p. 26 (Inland Sea of Japan).

*Habitat*.—Coasts of Southern Japan.

Head,  $5\frac{3}{4}$  in length; depth,  $4\frac{1}{4}$ . Eye, 8 in head. Dorsal, 128; anal, 104; scales, 120.

Snout a little more than one-third length of head; interorbital width one-half of diameter of eye. Two nostrils on left side; one between anterior parts of eyes, the other in front of lower eye. Maxillary extending to below middle of eye; rostral hook extending a little beyond mandibular symphysis. Three lateral lines; the two upper separated by 18 scales.

Color brownish with numerous irregular purplish spots. Total length 215 mm. (Regan.) Inland Sea of Japan.

This species has much smaller scales than *A. interruptus* or *A. joyneri*. We have seen no specimens.

(*purpureus*, purple; *maculatus*, spotted).

## 59. ARELISCUS SEMILÆVIS (Günther).

*Cynoglossus semilævis* GÜNTHER, Ann. Mag. Nat. Hist., 1873, p. 379 (Chifu).

*Habitat*.—Chinese shore of Sea of Japan.

Head, 5 in length to base of caudal; depth,  $3\frac{1}{2}$ . Dorsal, 123; anal, 95; scales, 145.

Two nostrils, one between the eyes, the other opposite lower margin of lower eye. Eyes extremely small, the upper not in advance of lower; interorbital space much wider than orbit. Length of snout two-fifths of head; angle of mouth below eye; nearer margin of snout than hind margin of opercle.

Color uniform brown; vertical fins with a white edge; 3 distinct round blackish spots on lateral line. Length, 18 inches. (Günther.)

Chifu, China, not seen by us.

(*semilævis*, half smooth.)

## 39. SYMPHURUS Rafinesque.

*Symphurus* RAFINESQUE, Indice d'Ittiologia Siciliana, 1810, p. 52 (*nigrescens*).

*Bibronia* COCCO, Alcuni Pesci del mare di Messina, 1844, p. 15 (*ligulata*; larval form).

*Plagusia* CUVIER, Règne Animal, 2d ed., II, 1829, p. 344 (based on *Plagusia* of BROWN); name preoccupied in Crustaceans, LATREILLE, 1806.

*Plagusia* BONAPARTE, Catalogo Metodico, 1846, p. 51 (*lactea*); substitute for *Plagusia* preoccupied.

*Aphoristia* KAUP, Archiv für Naturgesch., 1858, p. 106 (*ornata*).

*Glossichthys* GILL, Cat. Fish. E. Coast N. A., 1861, p. 51 (*plagiusa*).

*Ammopleturops* GÜNTHER, Cat., IV, 1862, p. 490 (*lacteus*=*nigrescens*).

? *Bascanius* SCHIÖDTE, Naturhist. Tydsskr., V, 1867, p. 269 (*tædifer*; larval form).

*Acedia* JORDAN, in JORDAN and GOSS, Review Flounders and Soles, 1889, p. 321 (*nebulosus*).

Body elongate, more or less lanceolate in outline, with the eyes and color on the left side; eyes small, very close together, with no distinct interorbital ridge between them; mouth small, twisted toward the blind side; teeth little developed, in villiform bands; edge of preopercle covered by the scales; gill openings narrow, the gill membranes adnate to the shoulder girdle above, joined together and free from the isthmus below; pectoral fins wanting (in the adult); vertical fins more or less confluent; scales ctenoid; lateral line wanting. Ventral fin of eyed side only present, free from the anal; head without fringes.

( $\sigma\upsilon\nu$ , together;  $\phi\acute{\upsilon}\omega$ , to grow;  $\omicron\upsilon\rho\acute{\alpha}$ , tail; from the united vertical fins).

#### 60. SYMPHURUS ORIENTALIS (Bleeker).

*Aphoristia orientalis* BLEEKER, Enum. Poiss. Connus. du Japon, 1879, p. 31, pl. II, fig. 1 (Japan).

*Symphurus orientalis* JORDAN and SNYDER, Check-List, 1901, p. 122.

*Symphurus* sp. SCHMIDT, Pisc. Mar. Orient, 1904, p. 249 (Vladivostok).

? *Achirus plagusia* BASILEWSKY, Soc. Nat. Mosc., 1855, p. 245 (Tchili; Pekin): not

*Pleuronectes plagusia* BLOCK and SNYDER, a Jamaican species of *Symphurus*.

*Habitat*.—Coasts of Japan, north of Vladivostok.

Head, 5 in length to caudal base; depth,  $3\frac{1}{2}$ . Eye,  $10\frac{1}{2}$  in head; maxillary,  $3\frac{2}{3}$ . Dorsal, 100; anal, 86; scales, 90.

Mouth curved but scarcely hooked at tip of upper jaw; snout projecting a little beyond mouth. Eyes small, the upper slightly in advance of lower; interorbital space about half vertical diameter of eye. Anterior nostril in a tube near front of upper jaw; posterior nostril in front of upper margin of lower eye. End of maxillary below posterior edge of pupil.

Origin of dorsal above front of upper eye. Ventral not joined to anal.

Color, dusky with 5 diffused dark cross bands, one across opercular region in front of ventral; one across body a little behind front of anal; the other three equally spaced, the last one just anterior to base of caudal. Fine points of dark color scattered profusely over the dorsal, caudal, and anal; the ventral uniform.

Here described from the plate published by Bleeker. The counts of fins and scales are from Bleeker's description and do not agree with the plate.

We have not seen this species, and do not feel sure of the characters ascribed to it. A young specimen of *Areliscus interruptus*, with the scales lost, may be easily taken for *Symphurus*.

(*orientalis*, Eastern.)

## SUMMARY.

Suborder **HETEROSOMATA.**Family **PLEURONECTIDÆ.**1. *Platophrys* Swainson, 1839.1. *myriaster* (Temminck and Schlegel), 1846; Keerun.2. *Scæops* Jordan and Starks, 1904.2. *grandisquama* (Schlegel), 1846; Nagasaki, Owari Bay, Sagami Bay, Wakanoura.3. *kobensis* Jordan and Starks, 1906; Kobe.3. *Engyprosopon* Günther, 1864.4. *ijimæ* Jordan and Starks, 1904; Suruga Bay.4. *Pseudorhombus* Bleeker, 1862.5. *cinnamomeus* (Schlegel), 1846; Tokyo, Tsuruga, Wakanoura, Kobe, Onomichi, Nagasaki, Hakata, Kawatana, Hongkong.6. *misakius* Jordan and Starks, 1906; Misaki, Kobe, Tsuruga, Wakanoura.7. *oligodon* (Bleeker), 1857; Formosa.8. *dupliocellatus* Regan, 1905.9. *ocellifer* Regan, 1905; Hakodate, Yokohama, Tokyo, Kobe, Wakanoura, Mororan, Nagasaki.10. *oligolepis* Bleeker, 1869.5. *Paralichthys* Girard, 1858.11. *olivaceus* (Schlegel), 1846; Hakodate, Mororan, Same, Aomori, Matsushima, Tokyo, Yokohama, Misaki, Wakanoura, Kobe, Onomichi, Hiroshima, Kawatana, Nagasaki.12. *coreanicus* (Schmidt), 1904.13. *percocephalus* (Basilevsky), 1855.6. *Xystrius* Jordan and Starks, 1904.14. *grigorjewi* (Herzenstein), 1890; Hakodate, Matsushima, Tokyo, Aomori, Uzen.7. *Verasper* Jordan and Gilbert, 1899.15. *variegatus* (Schlegel), 1846; Tokyo, Yokohama, Matsushima Bay, Onomichi.16. *moseri* Jordan and Gilbert, 1898; Iturup, Mororan, Hakodate, Same.8. *Acanthopsetta* Schmidt, 1903.17. *nadeshnyi* Schmidt, 1903.9. *Cynopsetta* Schmidt, 1903.18. *dubia* Schmidt, 1903; Uzen.10. *Hippoglossoides* Gottsche, 1835.19. *classodon* Jordan and Gilbert, 1880.20. *hamiltoni* Jordan and Gilbert, 1899.11. *Cleisthenes* Jordan and Starks, 1904.21. *pinetorum* Jordan and Starks, 1904; Matsushima Bay.



12. *Protopsetta* Schmidt, 1904.
22. *herzensteini* (Schmidt), 1904; Port Arthur.
13. *Hippoglossus* Cuvier, 1817.
23. *stenolepis* Schmidt, 1903.
14. *Reinhardtius* Gill, 1861.
24. *matsuurae* Jordan and Snyder, 1901; Sagami Bay.
15. *Atheresthes* Jordan and Gilbert, 1880.
25. *evermanni* Jordan and Starks, 1904; Matsushima Bay.
16. *Alxops* Jordan and Starks, 1904.
26. *plinthus* Jordan and Starks, 1904; Suruga Bay, Owari Bay.
17. *Pleuronichthys* Girard, 1854.
27. *cornutus* (Schlegel), 1846; Hakodate, Aomori, Tsuruga, Tokyo, Yokohama, Misaki, Wakanoura, Kobe, Onomichi, Hiroshima, Nagasaki.
18. *Lepidopsetta* Gill, 1864.
28. *bilineata* (Ayres), 1855.
19. *Limanda* Gottsche, 1835.  
(§ *Limanda*.)
29. *aspera* (Pallas), 1811; Robben Island.
30. *proboscidea* Gilbert, 1896.
31. *iridorum* Jordan and Starks, 1906; Mororan, Hakodate, Aomori.  
(§ *Limandella* Jordan and Starks, 1906.)
32. *schrencki* Schmidt, 1903.
33. *angustirostris* Kitahara, 1906; Aomori.
34. *yokohamæ* (Günther), 1880; Mororan, Hakodate, Aomori, Tsuruga, Onomichi, Yokohama, Tokyo, Kobe.
20. *Veraqua* Jordan and Starks, 1904.
35. *achne* Jordan and Starks, 1904; Matsushima Bay.
21. *Dexistes* Jordan and Starks, 1904.
36. *rikuzenius* Jordan and Starks, 1904; Matsushima Bay, Suruga Bay.
22. *Araias* Jordan and Starks, 1904.
37. *ariommus* Jordan and Starks, 1904; Matsushima Bay.
23. *Pleuronectes* Linnaeus, 1758.
38. *quadrituberculatus* Pallas, 1811; Robben Island.
24. *Liopsetta* Gill, 1864.
39. *obscura* (Herzenstein), 1890; Iturup Island.
40. *pinnifasciata* (Kner), 1870.
25. *Platichthys* Girard, 1854.
41. *stellatus* (Pallas), 1811; Mororan, Same, Tokyo, Hakodate, Matsushima, Robben Island.

26. *Kareius* Jordan and Snyder, 1900.

42. *bicoloratus* (Basilewsky), 1855; Otaru, Hakodate, Same, Mororan, Tokyo, Matsushima Bay.

27. *Clidoderma* Bleeker, 1862.

43. *asperrimum* (Schlegel), 1846; Hakodate, Mororan, Matsushima, Tokyo.

28. *Microstomus* Gottsche, 1835.

44. *kitaharæ* Jordan and Starks, 1904; Tsuruga, Suruga Bay, Tokyo.

45. *stelleri* Schmidt, 1904; Hakodate, Mororan, Edomo.

29. *Glyptocephalus* Gottsche, 1835.

(Species undescribed); Hakodate.

## FAMILY SOLEIDÆ.

30. *Amate* Jordan and Starks, 1906.

46. *japonica* (Schlegel), 1846; Misaki, Kobe, Wakanoura, Tokyo, Tsuruga, Nagasaki.

31. *Aseraggodes* Kaup, 1858.

47. *kobensis* (Steindachner), 1896; Nagasaki.

32. *Liachirus* Günther, 1862.

48. *nitidus* Günther, 1862; Formosa, Suzuki, Yamagawa.

33. *Zebrias* Jordan and Snyder, 1900.

49. *zebrinus* (Schlegel), 1846; Hakodate, Onomichi, Hiroshima, Tokyo, Kobe, Nagasaki, Formosa.

50. *japonicus* (Bleeker), 1869; Wakanoura, Tokyo.

34. *Æsopia* Kaup, 1858.

51. *cornuta* Kaup, 1858; Nagasaki.

35. *Paraplagusia* Bleeker, 1870.

52. *dipterygia* (Rüppell), 1828.

36. *Usinosita* Jordan and Snyder, 1900.

53. *japonica* (Schlegel), 1846; Tokyo, Same, Matsushima, Suruga Bay, Nagasaki.

37. *Cynoglossus* Buchanan-Hamilton, 1822.

54. *robustus* Günther, 1873; Yokohama, Tokyo, Kobe, Onomichi, Nagasaki.

55. *brunneus* Regan, 1905.

38. *Areliscus* Jordan and Snyder, 1900.

56. *interruptus* (Günther), 1880; Tokyo, Matsushima, Onomichi, Wakanoura, Nagasaki, Hiroshima.

57. *joyneri* (Günther), 1878; Tokyo.

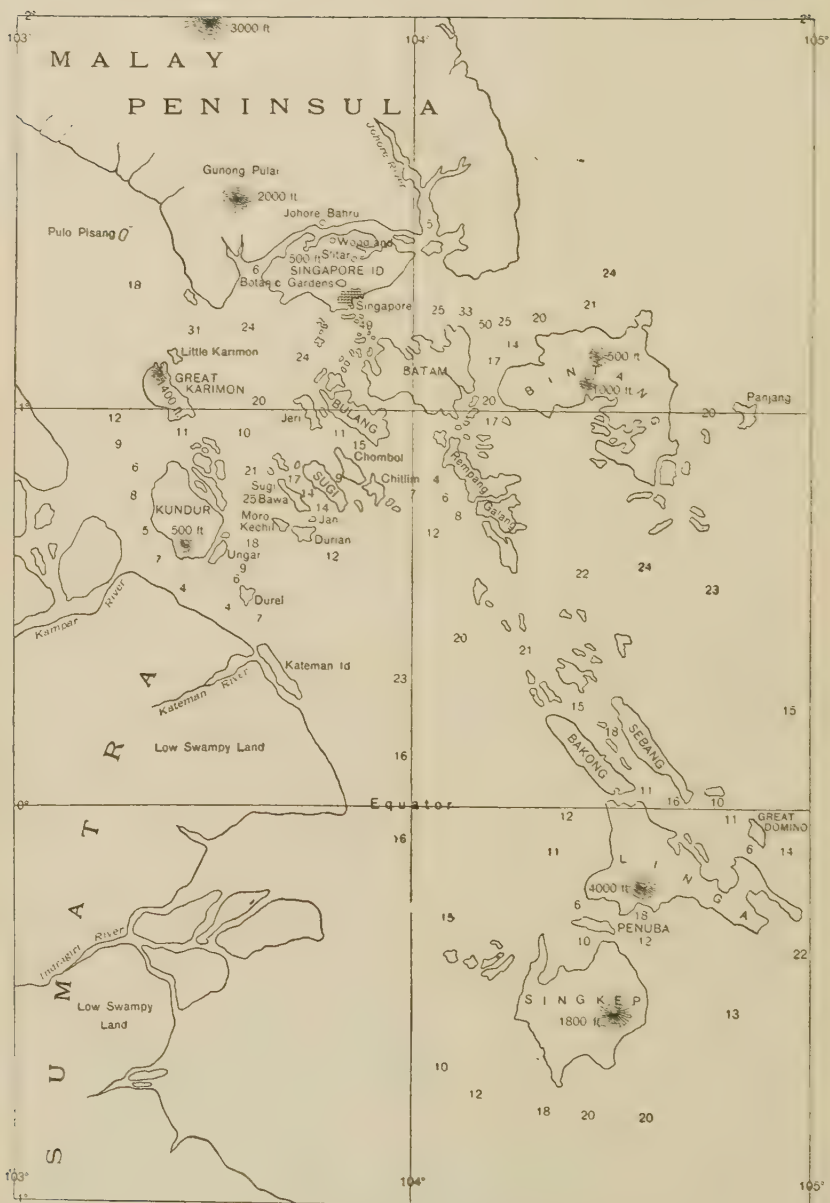
58. *purpureomaculatus* (Regan), 1905.

59. *semilævis* (Günther), 1873.

39. *Symphurus* Rafinesque, 1810.

60. *orientalis* (Bleeker), 1879.





MAP OF THE RHIO-LINGA ARCHIPELAGO.



## THE MAMMALS COLLECTED BY DR. W. L. ABBOTT IN THE RHIO-LINGA ARCHIPELAGO.

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The Rhio-Linga Archipelago is a series of small islands extending southeastward along the east coast of Sumatra from the southern extremity of the Malay Peninsula. The northernmost of the islands, Karimon, Batam, and Bintang are separated from the mainland by the narrow Malacca Strait on the west and Singapore Strait on the east, the average width of which is only about ten miles. Singapore Strait contains a mass of small islands on the north side, west of Singapore, which narrows the open water at that point to five miles. The easternmost, Karimon, Kundur, and Durei, are equally near the coast of Sumatra. From Karimon, the northeasternmost of the group, to the south shore of Sinkep, the southernmost, is a distance of about 150 miles, while that from Karimon east to Panjang is about 125 miles. Near the middle the Archipelago is partly divided by the Rhio Strait into two main groups, the Rhio<sup>a</sup> Archipelago proper at the north and the Linga Archipelago at the south. The principal islands of the Rhio Archipelago, the main axis of which extends east and west, are: *Karimon*,<sup>b</sup> *Kundur*, *Durei*, *Durian*, *Sugi*, Chombol, Bulang, Batam, Rempang Galong, *Bintang*, and Panjang. Of the Linga Archipelago, the main axis of which is nearly north and south, the more important islands are *Sebang*, *Bakong*, *Linga*, and *Sinkep*. In addition to these, the largest of which, Bintang, Linga, and Sinkep, are from 25 to 35 miles across, the Archipelago contains an almost infinite number of smaller islands and islets (see Map).

The entire group of islands lies in shallow water, mostly within the 20-fathom line, though Malacca and Singapore Straits reach a depth

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<sup>a</sup>The spelling *Rhio* is found on most German, English, and American maps; according to the Dutch authorities it should be *Riouw*.

<sup>b</sup>The names of islands visited by Dr. Abbott are printed in italics.

<sup>c</sup>Visited by Mr. C. B. Kloss.

of about 30 fathoms, while an isolated sounding of 49 fathoms is recorded between Singapore Island and Batam. The average depth of the water between the Archipelago and Sumatra is less than in the straits, that separating the Linga group from the larger island nowhere exceeding 20 fathoms, while that between the Rhio group and the coast scarcely reaches 10 fathoms. The causes which have led to these peculiarities in the conformation of the sea bottom have probably influenced the distribution of the mammals of the Archipelago, but our present knowledge of the fauna of the extreme southern portion of the Malay Peninsula is too imperfect to furnish any satisfactory proof.

The Archipelago has been visited four times by Dr. Abbott, in July, 1899 (Linga<sup>a</sup>), August, and September, 1901 (Linga and Sinkep<sup>b</sup>), August and September, 1902 (Bingtang, Sugi, Sugi Bawa<sup>c</sup>) and May, June, July, and August, 1903 (Karimon, Karimon Anak, Kundur, Ungar, Durian, Little Durian, Jan, Moro Kechil, Sanglar, Bakong, Panaga, Sebang, Penuba, Sinkep<sup>d</sup>). His collections of mammals, numbering about 700 specimens, all of which he has presented to the U. S. National Museum, form the subject of this paper. They are supplemented by a small but interesting lot from Batam, presented by Mr. C. B. Kloss.

So far as I am aware, the mammal fauna of the Rhio-Linga Archipelago was quite unknown previous to Dr. Abbott's explorations. Thus far the number of species taken is 49, but this will undoubtedly be much increased when the important islands of Chombol, Bulang, Rempang, Galong, and Panjang are visited. More than half of these, 28 in all, are, so far as is now known, peculiar to the Archipelago: *Tragulus nigrocinctus*, *T. formosus*, *T. lutescens*, *T. flavicollis*, *T. perflavus*, *T. pretiosus*, *T. pretiellus*, *T. nigricollis*, *T. rubeus*, *T. subrufus*, *Sus rhionis*, *Ratufa notabilis*, *R. conspicua*, *R. carimonensis*, *R. insignis*, *R. condurensis*, *R. confinis*, *Sciurus carimonensis*, *S. condurensis*, *Sciuropterus amoenus*, *Arctogalidia simplex*, *A. fusca*, *Paradoxurus brunneipes*, *Tupaia castanea*, *T. phæura*, *Nannoscirus pulcher*, *Presbytis rhionis*, and *P. cana*. Of the remaining species, 13 (*Manis javanica*,

<sup>a</sup> See Miller, Proc. Washington Acad. Sci., II, pp. 203-246, August 20, 1900.

<sup>b</sup> See Miller, Proc. Acad. Nat. Sci., Philadelphia, 1902, pp. 143-159, June 11, 1902.

<sup>c</sup> No general account of this collection has been published, but the following new species were described in 1903: (a) in paper entitled, Descriptions of Eleven new Malayan Mouse Deer (Proc. Biol. Soc. Washington, XVI, pp. 31-44, March 19, 1903), *Tragulus lutescens* (p. 32), *T. flavicollis* (p. 33), *T. formosus* (p. 34), *T. subrufus* (p. 37), *T. rubeus* (p. 40); (b) in paper entitled, Seventy new Malayan Mammals (Smithsonian Miscell. Coll., XLV, pp. 1-93, November 6, 1903), *Ratufa insignis* (p. 4), *Ratufa conspicua* (p. 5), *Tupaia castanea* (p. 54), *Presbytis rhionis* (p. 64).

<sup>d</sup> On this collection nothing has hitherto been published except the description of *Sus rhionis* and the record of *Sus oi* from Kundur (Proc. U. S. Nat. Mus., XXX, 1906, p. 741).

*Sciurus tenuis*, *Sciurus peninsularis*, *Rhinosciurus laticaudatus*, *Mus near rattus*, *Viverra zangalunga*, *Aomys cinerea*, *Tupaia ferruginea*, *T. malaccana*, *Cynocephalus volans*, *Emballonura peninsularis*, *Pteropus vampyrus*, and *Macaca fascicularis*) occur also in Sumatra and on the Malay Peninsula, 6 (*Sus oi*, *Mus firmus*, *M. lingensis*, *M. fremens*, *Tupaia tana*, and *Presbytis cristata*) are known elsewhere from Sumatra only, and 2 (*Mus concolor*, and *Cynopterus montanoi*) from the Malay Peninsula only. Among the 27 peculiar species the affinities of 22 (the 10 *Traguli*, (*Sus rhionis*, *Ratufa notabilis*, *R. conspicua*, *R. carimonensis*, *R. insignis*, *R. condurensis*, *Sciuropterus amoenus*, *Arctogalidia simplex*, *A. fusca*, *Paradoxurus brunneipes*, *Tupaia castanea*, and *T. phæura*) are geographically neutral, those of 4 *Sciurus carimonensis*, *S. condurensis*, *Presbytis rhionis*, and *P. cana*) incline distinctly toward Sumatra; while in only a single instance (*Ratufa confinis*) is there any marked likeness to a type apparently characteristic of the Malay Peninsula. From this analysis it seems evident that the relationships of the mammal fauna are more with Sumatra than with the mainland. Of the 49 recognized species 34, it is true, are in this respect neutral or noncommittal, but 11 show noticeable Sumatran affinities, while only 4 are specially related to peninsula forms. It should be remembered, however, that while the mammal fauna of the Archipelago is now fairly well elucidated, that of the neighboring large land areas is still very imperfectly known.

#### SYSTEMATIC LIST OF SPECIES.

##### Family MANIDÆ.

##### MANIS JAVANICA Desmarest.

1902. *Manis javanica* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 143, June 11, 1902.

An adult female was dug from a burrow in a hillside on Sinkep Island September 4, 1901 (Cat. No. 113114). Total length, 440 mm.; head and body, 220 mm.; tail, 220; weight, 4.7 kg.; skull (sutures distinct except in occipital region and floor of brain case), upper length (from upper rim of foramen magnum), 82.6 mm.; condylobasal length, 91; basal length, 85.4; palatal length, 57; length of nasals, 34.8; breadth of both nasals together at posterior extremity of premaxillaries, 9.8; lachrymal breadth, 24; breadth of braincase above roots of zygomatics, 33.8; zygomatic breadth, 30.6; mastoid breadth, 34; depth of brain case, 23.4; mandible, 65. The uterus contained a fœtus 92 mm. in length, but with the tail only 25 mm.; scales clearly outlined on head, body, and tail, but very indistinct on legs.

## Family TRAGULIDÆ.

## TRAGULUS NIGROCINCTUS, new species.

*Type*.—Adult male (skin and skull), Cat. No. 122863, U. S. N. M. Collected on Pulo Kundur, Rhio Archipelago, June 21, 1903, by Dr. W. L. Abbott. Original number, 2531.

*Characters*.—Resembling *Tragulus annæ* Matschie, but ear not specially elongated (about 30 mm. instead of 37–38 mm.); neck and back distinctly contrasted in color, and a faint but evident supraorbital stripe always present.

*Color*.—Type: Upper parts raw-sienna, fading to a buff considerably yellower than that of Ridgway on sides and darkening noticeably on outer surface of legs; the hairs everywhere light drab at base and black at tip. The black tips everywhere produce a heavy shading. This is distinctly in excess of the raw-sienna on back, but on sides the lighter color predominates. Neck clear black, contrasting rather noticeably with back. Crown and face very dark brown, faintly grizzled with a dull, light russet which becomes sufficiently concentrated over eye and along edge of naked loreal area to form a slight though evident stripe. Cheeks and haired portion of interramia a grizzle of black and dull russet. Throat clear black, without trace of light markings, except that posteriorly a few annulations slightly paler and more yellow than those on cheeks occur in the region usually occupied by the transverse band. Under parts yellowish buff like that of sides, fading to whitish gray in inguinal and hypogastric regions. On chest and anterior portion of belly the hairs are tipped with black, producing a grizzle as on sides; median line on chest blackish; this bordered anteriorly by an area of bright, clear ochraceous, into which the dark stripe quickly fades. A clear, nearly white, spot 20 mm. long by 10 mm. wide on each side of median line between front legs. Tail an indefinite dull tawny throughout, washed with blackish above. Ears and feet blackish.

*Skull and teeth*.—The skull is slightly larger than that of *Tragulus annæ*, but without making direct comparisons it is impossible to enter into details concerning the form. Teeth apparently as in *T. annæ*.

*Measurements*.—For external measurements see table, page 255. Cranial measurements of type: Greatest length, 210 mm.; upper length, 97.4; condylobasal length, 104; basal length, 97.8; palatal length, 70.8; diastema, 9.6; length of nasals, 29; greatest breadth of both nasals together, 11.6; zygomatic breadth, 45.8; least interorbital breadth, 28; mandible, 89; maxillary toothrow (alveoli), 38.6; maxillary premolars (crowns), 20; mandibular toothrow (alveoli), 44.2; mandibular premolars (crowns), 20.

*Specimens examined*.—Pulo Kundur, 19; Great Karimon, 2.



*Remarks.*—Individual variation in color is not very noticeable in this species. In some specimens the light grayish of the inguinal area is replaced by a clear yellowish buff; while in four, including the two from Great Karimon, the light color is intensified almost to a definite white, this taking place also in the axillary region. In one skin (female, Cat. No. 122851) from Pulo Kundur the black of the upper parts is so reduced that the raw-sienna is much in excess.

**TRAGULUS FORMOSUS** Miller.

1903. *Tragulus formosus* MILLER, Proc. Biol. Soc. Washington, XVI, p. 34, March 19, 1903.

Eleven specimens were trapped by Malays at Telok Pemudong, on the north shore of Bintang, August 11 to 18, 1902. For measurements see table, page 254.

**TRAGULUS LUTESCENS** Miller.

1903. *Tragulus lutescens* MILLER, Proc. Biol. Soc. Washington, XVI, p. 32, March 9, 1903.

Two were snared in the jungle on Pulo Sugi Bawa, September 2, 1902, and five trapped by natives on Pulo Jan, July 5 to 9, 1903. On both islands the animal was abundant. The five additional specimens confirm the characters of the species. All have the dark nape stripe well developed, none showing any tendency to approach *T. flavicollis*. For measurements see table, page 254.

**TRAGULUS FLAVICOLLIS** Miller.

1903. *Tragulus flavicollis* MILLER, Proc. Biol. Soc. Washington, XVI, p. 33, March 19, 1903.

The single known specimen of *Tragulus flavicollis* was trapped by Malays on Pulo Sugi, August 4, 1902. For measurements see table, page 254.

**TRAGULUS PERFLAVUS**, new species.

*Type.*—Adult female (skin and skull), Cat. No. 142125, U. S. N. M. Collected at Semimba Bay, Batam Island, September 21, 1905, by C. Boden Kloss. Original number, 28.

*Characters.*—A member of the *napu* group resembling *Tragulus flavicollis* in the absence of the dark nape stripe, but with general color more strongly yellow and white throat markings noticeably reduced.

*Color.*—General color above a light bright tawny-ochraceous fading to a yellowish ochraceous-buff on sides and median underparts and to a color intermediate between these two on cheeks and sides of neck. Middle area of crown and face darkened by a sprinkling of blackish hairs. Back and sides with the usual clouding of black, but

this nowhere in excess of the ground color. Neck clear and uniform, entirely without darker markings, the hairs noticeably whitish basally. On back the basal portion of the hairs is ecru-drab. Muzzle and loral stripe blackish. Region bordering upper edge of loral stripe noticeably paler than general hue of upperparts. Pattern of throat markings abnormal, the white stripes reduced both in length and width. Collar light yellowish ochraceous-buff, its width at middle about 15 mm. Dark stripes in front of collar darker and more brownish, with a few blackish hairs and annulations. Median and transverse white stripes not confluent anteriorly, 5—8 mm. in width, the median becoming indistinct at middle. Between the anterior termination of these stripes and the naked chin area the interramia is crossed by a band of light, dull, orange-buff. This is bordered on each side by the distinct anterior white stripe 55 mm. long by about 10 mm. wide. A white median area on chest and another in hypogastric and inguinal region, the latter continuous with the narrow white stripe extending down inner surface of thighs. Axilla and inner side of forearm grayish.

*Skull and teeth.*—The skull is larger than that of *Tragulus flavicollis*, but perhaps no more so than might be expected in an older individual. In general form it shows no peculiarities except that the rostrum is more produced, as shown by the longer nasals and diastema. The nasals are actually as well as relatively longer than in any skulls examined of female *T. formosus* or *T. lutescens*, the most nearly related species from the northern islands of the archipelago. Teeth large, but apparently in no respect unusual.

*Measurements.*—For external measurements see table, p. 254. Skull of type: Greatest length, 112 mm.; upper length, 102; condylobasal length, 102.8; basal length, 98; palatal length, 72; diastema, 16; length of nasals, 36.8; greatest breadth of both nasals together, 11.6; zygomatic breadth, 47; least interorbital breadth, 27.8; mandible, 87; maxillary toothrow (alveoli), 37; maxillary premolars (crowns), 18; mandibular toothrow (alveoli), 41.4; mandibular premolars (crowns), 18.

*Specimens examined.*—One, the type.

*Remarks.*—With its large size, strongly yellow color, and uniform pale neck, this species needs comparison with *Tragulus flavicollis* only. Though the material representing each animal is unsatisfactory, it appears to point unmistakably to their distinctness. Doctor Abbott writes that a second specimen of the Batam form taken by Mr. Kloss and now in the Singapore Museum exactly resembles the type.

“Several specimens since obtained from Pulo Galang by Kloss are either identical or closely allied to this.” W. L. A.

## TRAGULUS PRETIOSUS Miller.

1900. *Tragulus napa* MILLER, Proc. Washington Acad. Sci., II, p. 227, August 20, 1900. Not of F. Cuvier.

1902. *Tragulus pretiosus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 144, June 11, 1902.

During his first visit to Linga Doctor Abbott procured only one specimen of *Tragulus pretiosus*. In 1901 he took nine more. For measurements see table, page 254.

## TRAGULUS PRETIELLUS, new species.

*Type*.—Adult male (skin and skull), Cat. No. 122994, U.S.N.M. Collected on Pulo Bakong, Rhio Archipelago, July 18, 1903, by Dr. W. L. Abbott. Original number, 2643.

*Characters*.—Like *Tragulus pretiosus*, but noticeably smaller, and with relatively larger teeth.

*Color*.—The color so closely resembles that of *Tragulus pretiosus* that no detailed description is required.

*Measurements*.—For external measurements see table, page 254. Cranial measurements of type (those of the type of *T. pretiosus* in parentheses): Greatest length, 101.4 (108) mm.; upper length, 89.8 (98); condylo-basal length, 96.4 (101.6); basal length, 90.6 (96); palatal length, 66.2 (69.4); diastema, 10 (10.4); length of nasals, 29 (33.6); greatest breadth of both nasals together, 10.2 (11.8); zygomatic breadth, 45 (49); least interorbital breadth, 27 (28.8); mandible, 83 (89); maxillary toothrow (alveoli), 37.4 (36); maxillary premolars (crowns), 19 (18); mandibular toothrow (alveoli), 42 (41.4); mandibular premolars (crowns), 18.4 (19).

*Specimens examined*.—Pulo Bakong, 19; Pulo Sebang, 16.

*Remarks*.—This species is readily distinguishable from its nearest geographical ally, *Tragulus pretiosus*, by its smaller size, as shown in the table of measurements (page 254). From *Tragulus lutescens* of the more northern islands it differs in its much brighter color. The series of thirty-five specimens shows no specially noteworthy variations in color, and I can detect no tangible difference between the skins from the two islands.

## TRAGULUS NIGRICOLLIS Miller.

1902. *Tragulus nigricollis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 145. June 11, 1902.

Five specimens were taken in September, 1901. All were trapped in the jungle by natives. For measurements see table, page 255.

## TRAGULUS RUBEUS Miller.

1903. *Tragulus rubeus* MILLER, Proc. Biol. Soc. Washington, XVI, p. 40, March 19, 1903.

Five specimens were taken during August, 1902. For measurements see table, page 255.

## TRAGULUS SUBRUFUS Miller.

1902. *Tragulus javanicus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 143, June 11, 1902. Not *Cervus javanicus* OSBECK.

1903. *Tragulus subrufus* MILLER, Proc. Biol. Soc. Washington, XVI, p. 39, March 19, 1903.

Common on both Linga and Sinkep, and probably confined to these islands. Fourteen were taken on the former and five on the latter, all during August and September, 1901. For measurements see table, page 255.

Measurements of *Tragulus* from the Rhio-Linga Archipelago.

| Name.                           | Locality.         | Number.  | Sex.             | Total length. | Head and body. | Tail. | Hind foot. | Hind foot without hoofs. |
|---------------------------------|-------------------|----------|------------------|---------------|----------------|-------|------------|--------------------------|
|                                 |                   |          |                  | mm.           | mm.            | mm.   | mm.        | mm.                      |
| <i>Tragulus formosus</i> ...    | Pulo Bintang..... | 115508   | Male adult.....  | 620           | 540            | 80    | 142        | 129                      |
| Do.....                         | do.....           | α 115511 | do.....          | 600           | 530            | 70    | 137        | 124                      |
| Do.....                         | do.....           | 115517   | do.....          | 633           | 548            | 85    | 141        | 127                      |
| Do.....                         | do.....           | 115518   | do.....          | 605           | 530            | 75    | 142        | 129                      |
| Do.....                         | do.....           | 115510   | Female adult...  | 650           | 570            | 80    | 143        | 129                      |
| Do.....                         | do.....           | 115514   | do.....          | 620           | 535            | 85    | 142        | 129                      |
| Do.....                         | do.....           | 115516   | do.....          | 693           | 593            | 100   | 145        | 131                      |
| Do.....                         | do.....           | 115509   | Female immature. | 585           | 495            | 90    | 130        | 118                      |
| Do.....                         | do.....           | 115512   | do.....          | 487           | 412            | 75    | 123        | 110                      |
| Do.....                         | do.....           | 115513   | do.....          | 558           | 478            | 80    | 135        | 122                      |
| Do.....                         | do.....           | 115515   | do.....          | 590           | 500            | 90    | 131        | 118                      |
| <i>Taagulus lutescens</i> ...   | Pulo Sugi Bawa..  | 115506   | Female adult...  | 600           | 510            | 90    | 131        | 117                      |
| Do.....                         | do.....           | α 115507 | Male adult.....  | 563           | 488            | 75    | 131        | 117                      |
| Do.....                         | Pulo Jan.....     | 122968   | Female adult...  | 592           | 505            | 87    | 129        | 115                      |
| Do.....                         | do.....           | 122971   | do.....          | 620           | 540            | 80    | 133        | 120                      |
| Do.....                         | do.....           | 122969   | Male adult.....  | 675           | 503            | 72    | 130        | 118                      |
| Do.....                         | do.....           | 122970   | do.....          | 585           | 510            | 75    | 128        | 116                      |
| Do.....                         | do.....           | 122972   | do.....          | 578           | 503            | 75    | 130        | 118                      |
| <i>Tragulus flavicollis</i> ... | Pulo Sugi.....    | α 115505 | Female immature. | 600           | 520            | 80    | 132        | 117                      |
| <i>Tragulus perflavus</i> ...   | Pulo Batam.....   | α 142125 | Female adult...  | 620           | 535            | 85    | 135        | 122                      |
| <i>Tragulus pretiosus</i> ...   | Linga.....        | α 113031 | Male adult.....  | 625           | 545            | 80    | 135        | 120                      |
| Do.....                         | do.....           | 113025   | Female adult...  | 628           | 548            | 80    | 138        | 124                      |
| Do.....                         | do.....           | 113026   | do.....          | 675           | 565            | 90    | 140        | 125                      |
| Do.....                         | do.....           | 113029   | do.....          | 670           | 585            | 85    | 140        | 128                      |
| Do.....                         | do.....           | 113030   | do.....          | 670           | 580            | 90    | 141        | 127                      |
| Do.....                         | do.....           | 113032   | do.....          | 650           | 555            | 95    | 145        | 130                      |
| Do.....                         | do.....           | 113033   | do.....          | 590           | 510            | 80    | 138        | 124                      |
| <i>Tragulus pretiellus</i> ...  | Pulo Bakong.....  | 122987   | do.....          | 605           | 515            | 90    | 122        | 108                      |
| Do.....                         | do.....           | 122995   | do.....          | 610           | 515            | 95    | 126        | 113                      |
| Do.....                         | do.....           | 123000   | do.....          | 585           | 500            | 85    | 120        | 106                      |
| Do.....                         | do.....           | 123005   | do.....          | 575           | 500            | 75    | 123        | 107                      |
| Do.....                         | do.....           | 122988   | Male adult.....  | 533           | 473            | 60    | 119        | 105                      |
| Do.....                         | do.....           | 122990   | do.....          | 575           | 500            | 75    | 124        | 111                      |
| Do.....                         | do.....           | α 122994 | do.....          | 580           | 505            | 75    | 122        | 110                      |
| Do.....                         | do.....           | 122996   | do.....          | 565           | 500            | 65    | 126        | 112                      |
| Do.....                         | Pulo Sebang.....  | 123043   | do.....          | 580           | 505            | 75    | 134        | 118                      |
| Do.....                         | do.....           | 123048   | do.....          | 615           | 535            | 80    | 135        | 119                      |
| Do.....                         | do.....           | 123051   | do.....          | 580           | 513            | 67    | 129        | 115                      |
| Do.....                         | do.....           | 123053   | do.....          | 610           | 525            | 85    | 138        | 123                      |
| Do.....                         | do.....           | 123044   | Female adult...  | 600           | 525            | 75    | 136        | 123                      |
| Do.....                         | do.....           | 123046   | do.....          | 615           | 530            | 85    | 124        | 111                      |
| Do.....                         | do.....           | 123047   | do.....          | 605           | 525            | 80    | 130        | 116                      |
| Do.....                         | do.....           | 123049   | do.....          | 560           | 485            | 75    | 123        | 109                      |

α Type.



Measurements of *Tragulus* from the Rhio-Linga Archipelago—Continued.

| Name.                          | Locality.          | Number.             | Sex.              | Total length. | Head and body. | Tail. | Hind foot. | Hind foot without hoofs. |
|--------------------------------|--------------------|---------------------|-------------------|---------------|----------------|-------|------------|--------------------------|
|                                |                    |                     |                   | mm.           | mm.            | mm.   | mm.        | mm.                      |
| <i>Tragulus nigrocinctus</i> . | Pulo Kundur.....   | 122850              | Male adult.....   | 575           | 490            | 85    | 137        | 122                      |
| Do.....                        | do.....            | 122855              | do.....           | 580           | 490            | 90    | 132        | 118                      |
| Do.....                        | do.....            | 122856              | do.....           | 585           | 500            | 85    | 140        | 124                      |
| Do.....                        | do.....            | 122857              | do.....           | 615           | 520            | 95    | 140        | 125                      |
| Do.....                        | do.....            | 122860              | do.....           | 625           | 525            | 100   | 142        | 128                      |
| Do.....                        | do.....            | 122861              | do.....           | 570           | 490            | 80    | 132        | 118                      |
| Do.....                        | do.....            | 122862              | do.....           | 598           | 518            | 80    | 136        | 120                      |
| Do.....                        | do.....            | <sup>a</sup> 122863 | do.....           | 578           | 493            | 85    | 136        | 121                      |
| Do.....                        | do.....            | 122864              | do.....           | 595           | 510            | 85    | 133        | 120                      |
| Do.....                        | do.....            | 122867              | do.....           | 570           | 490            | 80    | 132        | 118                      |
| Do.....                        | do.....            | 122851              | Female adult..... | 537           | 457            | 75    | 137        | 120                      |
| Do.....                        | do.....            | 122853              | do.....           | 645           | 560            | 85    | 143        | 128                      |
| Do.....                        | do.....            | 122858              | do.....           | 635           | 550            | 85    | 140        | 128                      |
| Do.....                        | do.....            | 122859              | do.....           | 625           | 535            | 90    | 140        | 123                      |
| Do.....                        | do.....            | 122865              | do.....           | 598           | 513            | 85    | 140        | 126                      |
| Do.....                        | do.....            | 122866              | do.....           | 615           | 535            | 80    | 138        | 123                      |
| Do.....                        | Great Karimon..... | 122789              | do.....           | 590           | 510            | 80    | 132        | 118                      |
| Do.....                        | do.....            | 122791              | Male adult.....   | 590           | 510            | 80    | 130        | 118                      |
| <i>Tragulus nigricollis</i> .. | Sinkep.....        | 113121              | do.....           | 620           | 540            | 80    | 138        | 123                      |
| Do.....                        | do.....            | 113122              | do.....           | 647           | 570            | 77    | 148        | 133                      |
| Do.....                        | do.....            | 113124              | do.....           | 655           | 570            | 85    | 143        | 130                      |
| Do.....                        | do.....            | 113120              | Female adult..... | 645           | 560            | 85    | 143        | 128                      |
| Do.....                        | do.....            | 113123              | do.....           | 670           | 590            | 80    | 147        | 133                      |
| <i>Tragulus rubeus</i> .....   | Pulo Bintang.....  | 115519              | Male adult.....   | 540           | 465            | 75    | 119        | 106                      |
| Do.....                        | do.....            | 115521              | do.....           | 612           | 547            | 65    | 118        | 105                      |
| Do.....                        | do.....            | <sup>a</sup> 115522 | Female adult..... | 543           | 478            | 65    | 125        | 113                      |
| Do.....                        | do.....            | 115520              | Female immature.  | 460           | 390            | 70    | 116        | 108                      |
| <i>Tragulus subrufus</i> ....  | Sinkep.....        | 113117              | Female adult..... | 470           | 400            | 65    | 124        | 115                      |
| Do.....                        | do.....            | <sup>a</sup> 113119 | do.....           | 540           | 470            | 70    | 125        | 113                      |
| Do.....                        | do.....            | 113116              | Male adult.....   | 528           | 450            | 78    | 118        | 108                      |
| Do.....                        | Linga.....         | 113017              | do.....           | 500           | 450            | 50    | 119        | 105                      |
| Do.....                        | do.....            | 113020              | do.....           | 505           | 445            | 60    | 118        | 105                      |
| Do.....                        | do.....            | 113022              | do.....           | 490           | 440            | 50    | 114        | 100                      |
| Do.....                        | do.....            | 113014              | Female adult..... | 500           | 450            | 50    | 118        | 105                      |
| Do.....                        | do.....            | 113015              | do.....           | 497           | 442            | 55    | 118        | 108                      |
| Do.....                        | do.....            | 113016              | do.....           | 465           | 400            | 65    | 113        | 102                      |
| Do.....                        | do.....            | 113018              | do.....           | 535           | 465            | 70    | 117        | 104                      |
| Do.....                        | do.....            | 113021              | do.....           | 535           | 470            | 65    | 118        | 106                      |
| Do.....                        | do.....            | 113024              | do.....           | 510           | 440            | 70    | 120        | 109                      |

<sup>a</sup> Type.

## Family SUIDÆ.

## SUS OI Miller.

1902. *Sus oi* MILLER, Proc. Biol. Soc. Washington, XV, p. 51, March 5, 1902 (Indragiri River, eastern Sumatra).

A young male and a nearly adult female were "speared by Orang Mantong, in sago kebun at night," on Pulo Kundur, June 21, 1903. While these are the only specimens that have been received from the archipelago it is probable that the animal occurs on other islands that are sufficiently forested. Under date of April 21 and May 14, 1904, Doctor Abbott writes that seven of these pigs were recently killed on Pulo Batam, opposite Singapore, by a watchmaker named Maw. More recently (October 26, 1905) he writes that the animal is evidently common on Batam, and that he has examined a mounted specimen of an

adult male taken on the island by a Mr. Romenij, of Singapore.<sup>a</sup> The occurrence of this animal on Batam was recorded by Mr. R. Lydekker in *The Field*, August 13, 1904,<sup>b</sup> but apparently under the misunderstanding that this locality is part of the Malay Peninsula, an error repeated in a recent number of *Nature*.<sup>c</sup> The mistake is unfortunate, as no member of the *Sus barbatus* group is at present known from any part of the mainland, and the evidence that we now have, particularly Doctor Abbott's information that the Singapore hunters have never found *Sus oi* elsewhere than on Batam,<sup>d</sup> tends to indicate that no such pig occurs north of Singapore Strait. The essential part of Mr. Lydekker's note is as follows:

I have received from Dr. H. M. Ridley, superintendent of the Botanical Gardens at Singapore, two photographs of a wild boar recently shot by Mr. T. C. Romenieg in Pulan Battam, ten miles south of Singapore, which appear to indicate a species new to the Malay Peninsula. These photographs clearly show that the pig in question belongs to the long-nosed group represented typically by *Sus verrucosus* of Java, and *Sus barbatus* of Borneo. The animal is, however, identified by Mr. Ridley with the Sumatran representative of *Sus barbatus*, which an American naturalist, Mr. G. S. Miller, has recently described as a distinct species, under the name of *Sus oi*, from an abbreviation of the native term "nang-oi" . . . . As Doctor Volz remarks [*Zool. Jahrb., Abth. Syst.*, XX, p. 535, July 14, 1904], the discovery of the so-called *Sus oi* in Sumatra rendered the range of *Sus barbatus* coextensive with that of the orangutan. Now that *S. barbatus* is known to occur in the Malay Peninsula, one can not help wondering whether there is any possibility of the orang turning up in that area.

#### SUS RHIONIS Miller.

1906. *Sus rhionis* MILLER, Proc. U. S. National Museum, XXX, 1906, p. 749.

While only 12 specimens were procured (9 on Pulo Ungar, 2 on Pulo Sugi Bawa, and 1 on Great Karimon) the Rhio form of the *Sus vittatus* group is abundant throughout the archipelago. A single immature female (No. 113034, August 25, 1901) from Linga I am unable to identify satisfactorily as it is too young for the characters of the skull to be definitely shown.

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<sup>a</sup> While visiting the U. S. National Museum in June, 1904, Doctor Abbott said:

"Up to the present time about twenty-five to thirty of this species have been taken on Batam, mostly by Mr. Romenij; some by Mr. Maw.

"Batam is largely open ground; pineapple plantations, etc., with small patches of jungle, and is therefore easily driven with men and dogs. It is the only island in the Rhio Archipelago which could be shot over in this way. Some very large pigs inhabit Pulo Bintang, which are doubtless *Sus oi*. The mounted specimen in the Singapore Museum was shot by Mr. Romenij, but it is not any of those whose photographs were seen by Lydekker."

<sup>b</sup> *The Field*, CIV, p. 327.

<sup>c</sup> *Nature*, LXXIII, p. 35, November 9, 1905.

<sup>d</sup> See Miller, Proc. U. S. Nat. Mus., XXX, 1906, p. 741

## Family SCIURIDÆ.

## RATUFA NOTABILIS Miller.

1902. *Ratufa notabilis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 150, June 11, 1902.

The original two specimens of *Ratufa notabilis* are all that have yet been taken. They were shot on a hillside covered with secondary jungle at Mentuda Bay, west coast of Linga Island, August 24, 1901. For measurements see table, page 260.

## RATUFA CONSPICUA Miller.

1903. *Ratufa conspicua* MILLER, Smithsonian Miscell. Coll., XLV, p. 5, November 6, 1903.

Seven were taken by Doctor Abbott at Telok Pemudong, on the north side of Bintang, in August, 1902. The animals were common, but not easy to catch sight of. For measurements see table, page 260.

## RATUFA CARIMONENSIS, new species.

*Type*.—Adult female (skin and skull). Cat. No. 122813, U.S.N.M. Collected on Great Karimon Island, Rhio-Linga Archipelago, June 2, 1903, by Dr. W. L. Abbott. Original number, 2465.

*Characters*.—Similar to *Ratufa conspicua*, but with more white on face and on under side of tail.

*Color*.—The color so closely resembles that of *Ratufa conspicua* as to need no general description. Entire face so thickly sprinkled with whitish cream-buff that it appears to be an almost uniform dirty white as far back as a line joining middle of eyes. Under surface of tail with a clear whitish median area about 35 mm. in width extending from base to pencil.

*Skull and teeth*.—The skull and teeth resemble those of *Ratufa conspicua*, but are apparently somewhat larger. The difference is by no means constant.

*Measurements*.—For measurements see table, page 260.

*Specimens examined*.—Three, all from Great Karimon.

*Remarks*.—In the strong suffusion of white on the face, and in the broad whitish median stripe on the tail, this squirrel closely resembles *Ratufa notabilis* of Linga. Its size is, however, distinctly less, agreeing more closely with that of *R. conspicua*.

## RATUFA INSIGNIS Miller.

1903. *Ratufa insignis* MILLER, Smithsonian Miscell. Coll., XLV, p. 4, November 6, 1903. (Pulo Sugi.)

Four specimens, Pulo Sugi, August, 1902. For measurements see table, page 260.

## RATUFA CONDURENSIS new species.

*Type*.—Adult male (skin and skull), Cat. No. 122879, U.S.N.M. Collected on Pulo Kundur, Rhio-Linga Archipelago, June 25, 1903, by Dr. W. L. Abbott. Original number, 2552.

*Characters*.—Like *Ratufa insignis*, but underparts more washed with yellowish brown, feet heavily grizzled with tawny and black, and hairs of upper surface of tail noticeably pale through their basal half.

*Color*.—The general color is similar to that of *Ratufa insignis*, but the entire underparts are strongly suffused with buff-yellow. This deepens to orange-buff on throat and fades rather abruptly to a light cream-buff in hypogastric region and on inner surface of thighs. The evident though ill-defined line separating color of sides from that of underparts is very nearly the tawny of Ridgway. Feet grizzled with tawny and blackish, the ends of the toes darker. Entire face in front of ears lightly grizzled by minute whitish annulations on most of the hairs. The grizzle tends to become a whitish wash in front of eyes. Tail as in *Ratufa insignis*, but basal half of the hairs of upper surface cream-buff, whitening proximally, and showing through noticeably at surface even when the hairs are not disarranged.

*Skull and teeth*.—The skull and teeth do not differ appreciably from those of *Ratufa insignis*.

*Measurements*.—For measurements see table, page 260.

*Remarks*.—This squirrel is a member of a group of closely-related forms which are, so far as now known, confined to the Rhio-Linga Archipelago. As a group they may be at once recognized by the uniform dark umber-brown upper parts and tail (most of the hairs of the back and sides showing minute inconspicuous annulations near tip), sharply contrasted whitish cheeks, muzzle, and underparts, and usually whitish feet. The pale thigh patch is present but confluent with the light color of inner side of leg. Among themselves the five species now known differ as follows:

## KEY TO SPECIES.

Entire face conspicuously suffused with white.

Hind foot about 82 (73); greatest length of skull about 68 ... *Ratufa notabilis*

Hind foot about 75 (65); greatest length of skull about 64.

*Ratufa carimonensis*

Entire face brown, rather inconspicuously grizzled with white.

Brown of sides sharply contrasted with cream-buff of underparts without intervening tawny line ..... *Ratufa conspicua*

Brown of sides separated from cream-buff or orange-buff of underparts by a noticeable tawny line.

Feet clear whitish; hairs of upper surface of tail not conspicuously pale on basal half ..... *Ratufa insignis*

Feet heavily grizzled; hairs of upper surface of tail conspicuously pale on basal half ..... *Ratufa condurensis*



**RATUFA CONFINIS**, new species.

1902. *Ratufa affinis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 149, June 11,

1902. Not *Sciurus affinis* RAFFLES.

*Type*.—Adult female (skin and skull), Cat. No. 113134, U.S.N.M. Collected on Sinkep Island, Rhio-Linga Archipelago, September 3, 1901, by Dr. W. L. Abbott. Original number, 1265.

*Characters*.—Similar to *Ratufa affinis* but slightly larger; skull with larger and more elongated audital bullæ.

*Color*.—The color so exactly resembles that of *Ratufa affinis* as to need no detailed description.

*Skull and teeth*.—In general the skull and teeth resemble those of *Ratufa affinis*. The size of the skull, however, is slightly greater, and the difference appears to be constant. In seven adults of the Sinkep animal the greatest length of the skull averages 66 mm., with extremes of 64.6 and 68, while in eight adults of *Ratufa affinis* the average is 63.3, the extremes 63 and 64. The audital bullæ are relatively larger than in *Ratufa affinis*, and with the same constancy. In the specimens just mentioned their greatest diameter is: *confinis*, 16.4 (15.8 to 17); *affinis*, 14.5 (14 to 15). The teeth of the two animals do not differ appreciably.

*Measurements*.—For external measurements see table, page 260.

Cranial measurements of type: Greatest length, 68 (64)<sup>a</sup> mm.; basal length, 57 (54); basilar length, 52.4 (49); length of nasals along median suture, 21 (20); breadth of both nasals together anteriorly, 11.8 (12); breadth of both nasals together posteriorly, 8 (10); diastema, 14.8 (14.4); least interorbital breadth, 20 (22); zygomatic breadth, 40 (40.4); mandible, 42 (40); maxillary molar series (alveoli), 13 (12.6); mandibular molar series (alveoli), 13.8 (14).

*Specimens examined*.—Twelve; all from Sinkep Island.

*Remarks*.—Since I recorded this animal in 1902, Doctor Abbott has obtained a series of *Ratufa affinis* in Johore and Pahang. This additional material shows that the Sinkep form is distinct.

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<sup>a</sup> Measurements in parentheses are those of an adult female *Ratufa affinis* from Rumpin River, Pahang (No. 115388).

Measurements of *Ratufa* from the Rhio-Linga Archipelago.

| Name.                            | Locality.          | Number. | Sex.        | Total length. | Head and body. | Tail. | Hind foot. | Hind foot without claws. |
|----------------------------------|--------------------|---------|-------------|---------------|----------------|-------|------------|--------------------------|
|                                  |                    |         |             | mm.           | mm.            | mm.   | mm.        | mm.                      |
| <i>Ratufa notabilis</i> .....    | Linga.....         | 113065  | Female...   | 780           | 335            | 445   | 80         | 72                       |
| Do.....                          | do.....            | 113064  | Male.....   | 780           | 345            | 435   | 82         | 73                       |
| <i>Ratufa conspicua</i> .....    | Pulo Bintang.....  | 115525  | Female..... | 710           | 330            | 380   | 75         | 68                       |
| Do.....                          | do.....            | 115526  | do.....     | 730           | 340            | 380   | 70         | 62                       |
| Do.....                          | do.....            | 115527  | do.....     | 620           | 280            | 340   | 70         | 63                       |
| Do.....                          | do.....            | 115523  | Male.....   | 693           | 328            | 365   | 70         | 64                       |
| Do.....                          | do.....            | 115524  | do.....     | 690           | 305            | 385   | 74         | 67                       |
| Do.....                          | do.....            | 115528  | do.....     | 705           | 330            | 375   | 77         | 72                       |
| Do.....                          | do.....            | 115529  | do.....     | 743           | 338            | 405   | 76         | 70                       |
| <i>Ratufa carimonensis</i> ..... | Great Karimon..... | 122813  | Female..... | 683           | 345            | 338   | 74         | 66                       |
| Do.....                          | do.....            | 122811  | Male.....   | 710           | 325            | 385   | 75         | 68                       |
| Do.....                          | do.....            | 122812  | do.....     | 705           | 320            | 385   | 74         | 67                       |
| <i>Ratufa insignis</i> .....     | Pulo Sugi.....     | 115530  | Female..... | 725           | 325            | 400   | 75         | 69                       |
| Do.....                          | do.....            | 115532  | do.....     | 730           | 355            | 385   | 70         | 64                       |
| Do.....                          | do.....            | 115531  | Male.....   | 780           | 360            | 420   | 76         | 70                       |
| Do.....                          | do.....            | 115533  | do.....     | 785           | 365            | 420   | 76         | 70                       |
| <i>Ratufa condurensis</i> .....  | Pulo Kundur.....   | 122878  | Female..... | 675           | 315            | 360   | 72         | 66                       |
| Do.....                          | do.....            | 122881  | do.....     | 730           | 355            | 385   | 73         | 65                       |
| Do.....                          | do.....            | 122882  | do.....     | 625           | 345            | 280   | 69         | 63                       |
| Do.....                          | do.....            | 122879  | Male.....   | 725           | 340            | 385   | 71         | 64                       |
| Do.....                          | do.....            | 122880  | do.....     | 720           | 355            | 385   | 74         | 68                       |
| <i>Ratufa confinis</i> .....     | Sinkep.....        | 113132  | Female..... | 740           | 345            | 395   | 77         | 72                       |
| Do.....                          | do.....            | 113134  | do.....     | 770           | 345            | 425   | 72         | 65                       |
| Do.....                          | do.....            | 113138  | do.....     | 705           | 355            | 370   | 75         | 69                       |
| Do.....                          | do.....            | 113139  | do.....     | 750           | 340            | 410   | 74         | 65                       |
| Do.....                          | do.....            | 113140  | do.....     | 770           | 345            | 425   | 75         | 66                       |
| Do.....                          | do.....            | 113141  | do.....     | 780           | 345            | 435   | 74         | 67                       |
| Do.....                          | do.....            | 113136  | Male.....   | 678           | 303            | 375   | 67         | 62                       |
| Do.....                          | do.....            | 113137  | do.....     | 735           | 325            | 410   | 71         | 64                       |
| Do.....                          | do.....            | 113142  | do.....     | 625           | 265            | 360   | 65         | 59                       |

## SCIURUS CONDURENSIS, new species.

*Type*.—Adult female (skin and skull). Cat. No. 122876, U.S.N.M. Collected on Pulo Kundur, Rhio-Linga Archipelago, June 13, 1903, by Dr. W. L. Abbott. Original number, 2486.

*Characters*.—A member of the *prevostii* group, closely resembling *Sciurus melanops*<sup>a</sup> of the neighboring east coast of Sumatra, but with shoulder white, scarcely tinged with reddish brown.

*Color*.—Upperparts and entire tail shining black. Underparts, feet, and inner surface of legs orange-rufous, blackening on chin and about mammae. Outer surface of upperarm a paler shade of orange-rufous. Cheeks and sides of neck black, faintly grizzled by minute whitish annulations on most of the hairs. A whitish patch 15 mm. in diameter at base of whiskers, and another 5 mm. in diameter about 10 mm. below posterior canthus of eye. Ears clear black throughout. The whitish cream-buff lateral stripe is of the usual character. It covers outer side of hind leg and extends forward to front of shoulder where it is abruptly outlined against the black neck. On shoulder it is very faintly tinged with reddish brown.

*Skull and teeth*.—The skull and teeth are similar to those of *Sciurus melanops*.

<sup>a</sup>Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 151, June 11, 1902. Indragiri River, Sumatra.

*Measurements*.—For measurements see table, page 262.

*Specimens examined*.—Eight, all from Pulo Kundur.

*Remarks*.—The differences in color between this squirrel and *Sciurus melanops* though slight are very constant. The Sumatran animal is now represented in the U. S. National Museum by ten specimens, three from the Indragiri River and seven from the Kateman. In all of these without exception the shoulder is distinctly red, concolor with outer surface of upperarm, and the white stripe ends abruptly at its narrowest region, just behind shoulder. In the eight *S. carimonensis*, on the other hand, the white extends across shoulder to base of neck, with merely a faint, indefinite wash of red near juncture of arm.

**SCIURUS CARIMONENSIS, new species.**

*Type*.—Adult female (skin and skull), Cat. No. 122800, U.S.N.M. Collected on Great Karimon Island, Rhio-Linga Archipelago, May 24, 1903, by Dr. W. L. Abbott. Original number, 2423.

*Characters*.—A member of the *prevostii* group similar to *Sciurus melanops* but smaller, shoulder less washed with red, and side of neck below and behind ear grizzled gray in noticeable contrast with surrounding parts.

*Color*.—The color is in general exactly like that of *Sciurus condurensis*. Shoulder mostly white, but strongly washed with orange-rufous, the red becoming along border of dark neck area as clear and bright as that of upper arm. Face slightly more grizzled than in *Sciurus melanops* and *S. condurensis*, but the usual whitish spots of normal size and character. On side of neck below and behind ear the white becomes the predominant element in the grizzle, producing a distinct, though not sharply defined light area.

*Skull and teeth*.—Except that they are smaller the skull and teeth do not differ appreciably from those of *Sciurus melanops* and *S. condurensis*.

*Measurements*.—For external measurements see table, page 262.

Cranial measurements of type: Greatest length, 56 (57)<sup>a</sup> mm.; basal length, 49 (51); basilar length, 46 (48); palatal length, 24.6 (26); diastema, 13 (14); length of nasals, 17 (18.8); interorbital breadth, 23.4 (23); zygomatic breadth, 35 (34); mandible, 36.6 (38); maxillary tooth row (alveoli), 11 (11); mandibular tooth row (alveoli), 10.4 (11.4).

*Specimens examined*.—Fifteen (one in alcohol), all from Great Karimon.

*Remarks*.—The characters of this form are quite as constant as those of *Sciurus condurensis*. The color of the shoulder is almost exactly intermediate between that in the two closely related species, but the slightly smaller size, and the gray sides of the neck are sufficiently diagnostic. These two insular species together with the Sumatran

<sup>a</sup>Measurements in parentheses are those of the type of *Sciurus melanops*.

*Sciurus melanops*, *S. rafflesi*, and *S. harrisoni*,<sup>a</sup> form a section of the *precostii* group characterized by the dark-grayish or blackish cheeks with conspicuous white patch on muzzle at base of whiskers and smaller white spot below eye at base of cheek bristles. From each other they are distinguishable as follows:

## KEY TO SPECIES.

Many hairs of the tail with whitish subterminal ring 3-4 mm. in width. *S. harrisoni*  
Tail not grizzled except occasionally at extreme base below.

Shoulder concolor with outer surface of upper arm:

Hind foot about 56 (53); shoulder chestnut ..... *S. rafflesi*

Hind foot about 60 (56); shoulder orange-ochraceous ..... *S. melanops*

Shoulder much lighter than outer surface of upper arm; more white than black in grizzle on sides of neck; shoulder distinctly washed with reddish ..... *S. carimonensis*

More black than white in grizzle on sides of neck; shoulder scarcely washed with reddish ..... *S. condurensis*

*Measurements of Sciurus carimonensis and S. condurensis from the Rhio-Linga Archipelago.*

| Name.                          | Locality.        | Number. | Sex.             | Total length. | Head and body. | Tail. | Hind foot. | Hind foot without claws. |
|--------------------------------|------------------|---------|------------------|---------------|----------------|-------|------------|--------------------------|
|                                |                  |         |                  | mm.           | mm.            | mm.   | mm.        | mm.                      |
| <i>Sciurus carimonensis</i> .. | Great Karimon... | 122796  | Female adult...  | 485           | 245            | 240   | 50         | 45                       |
| Do.....                        | do.....          | 122797  | do.....          | 482           | 247            | 235   | 52         | 47                       |
| Do.....                        | do.....          | 122798  | do.....          | 502           | 253            | 249   | 51         | 45                       |
| Do.....                        | do.....          | 122800  | do.....          | 485           | 245            | 240   | 49         | 42                       |
| Do.....                        | do.....          | 122803  | do.....          | 478           | 248            | 230   | 51         | 44                       |
| Do.....                        | do.....          | 122806  | do.....          | 485           | 265            | 220   | 51         | 45                       |
| Do.....                        | do.....          | 122793  | Male adult.....  | 490           | 245            | 245   | 50         | 45                       |
| Do.....                        | do.....          | 122794  | do.....          | 474           | 248            | 225   | 49         | 42                       |
| Do.....                        | do.....          | 122795  | do.....          | 480           | 240            | 240   | 50         | 44                       |
| Do.....                        | do.....          | 122799  | do.....          | 486           | 246            | 240   | 50         | 45                       |
| Do.....                        | do.....          | 122801  | do.....          | 487           | 252            | 235   | 51         | 46                       |
| Do.....                        | do.....          | 122804  | do.....          | 488           | 248            | 240   | 51         | 46                       |
| Do.....                        | do.....          | 122805  | do.....          | 495           | 255            | 235   | 48         | 44                       |
| Do.....                        | do.....          | 122807  | do.....          | 460           | 240            | 220   | 49         | 42                       |
| <i>Sciurus condurensis</i> ..  | Pulo Kundur..... | 122870  | Female adult...  | 520           | 270            | 250   | 49         | 44                       |
| Do.....                        | do.....          | 122872  | do.....          | 500           | 260            | 240   | 52         | 46                       |
| Do.....                        | do.....          | 122873  | do.....          | 530           | 265            | 265   | 51         | 47                       |
| Do.....                        | do.....          | 122874  | Female immature. | 458           | 223            | 235   | 51         | 47                       |
| Do.....                        | do.....          | 122875  | Female adult...  | 520           | 270            | 250   | 53         | 48                       |
| Do.....                        | do.....          | 122876  | do.....          | 510           | 267            | 243   | 52         | 48                       |
| Do.....                        | do.....          | 122877  | do.....          | 510           | 267            | 243   | 50         | 45                       |
| Do.....                        | do.....          | 122871  | Male adult.....  | 495           | 260            | 235   | 51         | 46                       |

<sup>a</sup>Type.

## SCIURUS TENUIS Raffles.

1900. *Sciurus tenuis* MILLER, Proc. Washington Acad. Sci., II, p. 221, August 20, 1900.

The specimen that Doctor Abbott procured on his first visit to Linga is the only one that he has taken in the archipelago.

<sup>a</sup>Stone and Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 132, June 4, 1902. (Goenong Sægi, Lampong District.) I am indebted to Mr. Witmer Stone and the authorities of the Academy of Natural Sciences of Philadelphia for the opportunity to examine the specimen on which this name was based. I have also examined the type of *Sciurus rafflesi* in the British Museum.



## SCIURUS PENINSULARIS Miller.

1900. *Sciurus notatus* MILLER, Proc. Washington Acad. Sci., II, p. 224, August 20, 1900. (Linga). Not *Sciurus notatus* Boddaert.  
1902. *Sciurus vittatus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 151, June 11, 1902. (Part, specimens from Linga and Sinkep.) Not *Sciurus vittatus* RAFFLES.  
1903. *Sciurus peninsularis* MILLER, Smithsonian Miscell. Coll., XLV, p. 10, November 6, 1903. (Pahang, type locality, and Singapore.)

The fifty squirrels of the *vittatus* group taken in the archipelago appear to be referable to *Sciurus peninsularis*. They are from the following islands: Sinkep (8), Penuba (8), Linga (5), Sebang (4), Sanglar (7), Bintang (4), Batam (2), Sugi (9), and Little Karimon (3). While the series differ slightly among themselves, I can find no tangible characters on which to separate the forms occurring on the various islands. In general the specimens from the southern localities tend to be paler than those from farther north. They all agree with *Sciurus peninsularis* and differ from *S. vittatus* in the color of the cheeks and underparts. In none is there a trace of clear red in the tail. For measurements see table, page 264.

## RHINOSCIURUS LATICAUDATUS (Müller and Schlegel.)

1902. *Rhinosciurus laticaudatus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 154. June 11, 1902. (Linga.)

A very old male, snared by natives, was procured on Linga Island August 28, 1901. I have not been able to compare it with the Bornean animal. Its measurements are: Total length, 278 mm.; head and body, 213; tail vertebrae, 65; hind foot, 41 (38.5); skull, greatest length, 56; basal length, 49; basilar length, 46.4; nasals, 20.4; greatest breadth of both nasals together, 5.8; diastema, 16.4; zygomatic breadth, 28; least interorbital breadth, 13.8; mandible, 35; maxillary tooth row (alveoli), 11.8; mandibular tooth row (alveoli), 11.

Measurements of *Sciurus peninsularis* from the Rhio-Linga Archipelago.

| Name.                             | Locality.          | Number. | Sex.              | Total length. | Head and body. | Tail. | Hind foot. | Hind foot, without claws. |
|-----------------------------------|--------------------|---------|-------------------|---------------|----------------|-------|------------|---------------------------|
|                                   |                    |         |                   | mm.           | mm.            | mm.   | mm.        | mm.                       |
| <i>Sciurus peninsularis</i> ..... | Sinkep.....        | 113126  | Female adult...   | 390           | 210            | 180   | 45         | 40                        |
| Do.....                           | do.....            | 113127  | do.....           | 400           | 205            | 195   | 45         | 41                        |
| Do.....                           | do.....            | 113129  | do.....           | 417           | 212            | 195   | 46         | 42                        |
| Do.....                           | do.....            | 123101  | do.....           | 410           | 215            | 195   | 43         | 39                        |
| Do.....                           | do.....            | 123102  | do.....           | 410           | 215            | 195   | 42         | 37                        |
| Do.....                           | do.....            | 113128  | Male adult.....   | 395           | 215            | 180   | 45         | 42                        |
| Do.....                           | do.....            | 113130  | do.....           | 360           | 190            | 170   | 39         | 35                        |
| Do.....                           | do.....            | 123100  | do.....           | 388           | 210            | 178   | 42         | 37                        |
| Do.....                           | Pulo Penuba.....   | 123075  | Female adult...   | 387           | 210            | 177   | 44         | 40                        |
| Do.....                           | do.....            | 123076  | do.....           | 383           | 208            | 175   | 42         | 37                        |
| Do.....                           | do.....            | 123078  | do.....           | 376           | 200            | 176   | 44         | 38                        |
| Do.....                           | do.....            | 123079  | do.....           | 383           | 210            | 173   | 45         | 41                        |
| Do.....                           | do.....            | 123072  | Male adult.....   | 355           | 200            | 155   | 44         | 40                        |
| Do.....                           | do.....            | 123073  | do.....           | 325           | 215            | 110   | 44         | 41                        |
| Do.....                           | do.....            | 123074  | do.....           | 380           | 200            | 180   | 42         | 38                        |
| Do.....                           | do.....            | 123077  | do.....           | 370           | 205            | 165   | 44         | 41                        |
| Do.....                           | Linga.....         | 101604  | Female adult..... | 420           | 210            | 210   | 42         | 37                        |
| Do.....                           | do.....            | 101606  | Female immature.  | 380           | b 190          | 190   | 41         | 37                        |
| Do.....                           | do.....            | 101607  | Female adult..... | 370           | b 195          | 175   | 39         | 35                        |
| Do.....                           | do.....            | 113062  | do.....           | 345           | 200            | 145   | 44         | 40                        |
| Do.....                           | do.....            | 113063  | Male adult.....   | 373           | 208            | 165   | 44         | 40                        |
| Do.....                           | Pulo Sebang.....   | 123054  | Female adult..... | 404           | 218            | 185   | 45         | 41                        |
| Do.....                           | do.....            | 123057  | do.....           | 380           | 205            | 175   | 43         | 39                        |
| Do.....                           | do.....            | 123055  | Male adult.....   | 375           | 200            | 175   | 43         | 39                        |
| Do.....                           | do.....            | 123056  | do.....           | 405           | 215            | 190   | 46         | 43                        |
| Do.....                           | Pulo Sanglar.....  | 122977  | Female adult..... | 395           | 210            | 185   | 45         | 41                        |
| Do.....                           | do.....            | 122973  | Male adult.....   | 390           | 212            | 178   | 44         | 41                        |
| Do.....                           | do.....            | 122974  | do.....           | 385           | 205            | 180   | 44         | 41                        |
| Do.....                           | do.....            | 122975  | do.....           | 370           | 200            | 170   | 45         | 41                        |
| Do.....                           | do.....            | 122976  | do.....           | 380           | 210            | 170   | 46         | 43                        |
| Do.....                           | do.....            | 122978  | do.....           | 378           | 210            | 168   | 44         | 41                        |
| Do.....                           | do.....            | 122979  | do.....           | 368           | 200            | 168   | 44         | 40                        |
| Do.....                           | Pulo Batam.....    | 142149  | do.....           | 380           | 210            | 170   | 48         | 43.8                      |
| Do.....                           | do.....            | 142150  | do.....           | 375           | 203            | 172   | 44         | 40                        |
| Do.....                           | Pulo Bintang.....  | 115536  | Female adult..... | 405           | 220            | 185   | 47         | 43                        |
| Do.....                           | do.....            | 115537  | do.....           | 415           | 215            | 200   | 45         | 41                        |
| Do.....                           | do.....            | 115534  | Male adult.....   | 355           | 215            | 140   | 47         | 44                        |
| Do.....                           | do.....            | 115535  | do.....           | 413           | 220            | 193   | 47         | 44                        |
| Do.....                           | Great Karimon..... | 122809  | Female adult..... | 365           | 198            | 167   | 43         | 39                        |
| Do.....                           | do.....            | 122810  | do.....           | 378           | 203            | 175   | 43         | 39                        |
| Do.....                           | do.....            | 122808  | Male adult.....   | 372           | 202            | 170   | 42         | 39                        |
| Do.....                           | Pulo Sugi.....     | 115540  | Female adult..... | 394           | 210            | 184   | 45         | 41                        |
| Do.....                           | do.....            | 115541  | do.....           | 380           | 207            | 173   | 45         | 41                        |
| Do.....                           | do.....            | 115544  | do.....           | 375           | 207            | 168   | 44         | 40                        |
| Do.....                           | do.....            | 115545  | do.....           | 368           | 194            | 174   | 45         | 42                        |
| Do.....                           | do.....            | 115546  | Female immature.  | 360           | 190            | 170   | 43         | 40                        |
| Do.....                           | do.....            | 115538  | Male adult.....   | 370           | 205            | 165   | 43         | 40                        |
| Do.....                           | do.....            | 115539  | do.....           | 360           | 200            | 160   | 43         | 40                        |
| Do.....                           | do.....            | 115532  | do.....           | 405           | 220            | 185   | 46         | 43                        |
| Do.....                           | do.....            | 115543  | do.....           | 393           | 218            | 175   | 45         | 41                        |

a Tail imperfect.

b From skin.

## SCIUROPTERUS AMÆNUS, new species.

*Type*.—Adult male (skin and skull), Cat. No. 122883, U.S.N.M. Collected on Pulo Kundur, Rhio-Linga Archipelago, June 12, 1903.

*Characters*.—Like *Sciuropterus aurantiacus* (Wagner), but skull noticeably larger and nasal bones much more abruptly widened anteriorly.

*Color*.—Upper parts and outer surface of legs a reddish brown, varying according to light from ochraceous to dull ochraceous-rufous, the slate-black under color appearing irregularly at surface, particularly on sides of body and on flying membrane. Cheeks and lips yel-

lowish ochraceous-buff. Under parts buffy white, somewhat clouded by the slate-gray bases of the hairs. Chest, scrotum, and under surface of membranes washed with ochraceous buff. Extreme edge of membranes cream-buff, becoming whitish posteriorly. Tail a yellowish ochraceous-buff at base and along edges; elsewhere heavily clouded with a dark Prout's brown. Feet scantily clothed with very short hairs, these yellowish on front feet, the terminal phalanges of the fingers brown, mixed brown and yellowish on hind feet, the terminal phalanges of the toes white.

*Skull and teeth.*—As compared with a skull of *Sciuropterus aurantiacus* from Banka, the type locality, figured by Jentink,<sup>a</sup> that of *S. amannus* is readily distinguishable by its larger size, broader rostrum, and by the peculiar abrupt widening of the nasal bones anteriorly, which causes the side of the rostrum to be distinctly concave immediately behind the region of their greatest width. As in *S. aurantiacus*, the mastoid bullæ are considerably inflated, projecting backward sufficiently to be in line with upper rim of foramen magnum. Teeth as in *Sciuropterus aurantiacus*.

*Measurements.*—Total length, 308 mm.; head and body, 165; tail vertebrae, 143; hind foot, 31 (28.6); skull, greatest length, 37.8; condylo-basal length, 35.4; basilar length, 29.6; palatal length, 19; diastema, 7.8; length of nasal, 9; greatest breadth of both nasals together, 6.4; least breadth of both nasals together, 2.8; zygomatic breadth, 23; inter-orbital constriction, 8; breadth of braincase above roots of zygomata, 17.6; mastoid breadth, 19; mandible, 22.8; maxillary tooththrow (alveoli), 7.6; mandibular tooththrow (alveoli), 7.

*Specimens examined.*—One, the type.

*Remarks.*—Doctor Jentink has kindly compared a photograph of the skull of this animal with the specimen *Sciuropterus aurantiacus*, in the Leyden Museum. He writes me that his published figure is exactly natural size and that it perfectly represents the original;<sup>b</sup> furthermore, that he agrees with me regarding the Pulo Kundur squirrel as distinct.

#### NANNOSCIURUS PULCHER Miller.

1902. *Nannosciurus pulcher* MILLER, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 153, June 11, 1902.

1906. *Nannosciurus pulcher* LYON, Proc. Biol. Soc. Washington, XIX, p. 53, May 1, 1906.

Doctor Abbott shot the type of this species on a small tree trunk in heavy forest at Sakana Bay, northwest corner of Sinkep Island, September 4, 1901. He did not meet with the animal again until August, 1903, when he found it common in a patch of jungle near the

<sup>a</sup> Notes from the Leyden Museum, XII, 1890, pl. VII, figs. 11 and 12.

<sup>b</sup> The excellence and accuracy of the plate I have myself verified in the case of the three type specimens figured on it. Unfortunately, when examining the squirrels in the Leyden Museum, I neglected to take notes on the skull of *S. aurantiacus*.

shore a few miles farther east on the same island. "I heard a number" he writes, "but only saw the two I shot. The voice is a very high-pitched thin little whistle, kept up several minutes at a time like the 'scolding' of bigger squirrels."

### Family MURIDÆ.

#### MUS FIRMUS Miller.

1902. *Mus firmus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 155, June 11, 1902. (Linga.)

Great Karimon (5), Sugi (5), Sugi Bawa (3), Moro Besar (2), Bakong (4), Sebang (2), Linga (5).

This is a common rat throughout the Archipelago, though not as abundant as the members of the *rattus* and *surifer* groups. For measurements see table, page 268.

#### MUS LINGENSIS Miller.

1900. *Mus lingensis* MILLER, Proc. Washington Acad. Sci., II, p. 206, August 20, 1900. (Linga.)

1902. *Mus lingensis* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 154, June 11, 1902. (Linga and Sinkep.)

Great Karimon (21), Sugi (2), Sugi Bawa (4), Batam (4), Bintang (6), Moro Besar (1), Moro Kechil (7); Bakong (22), Sebang (8), Linga (17), Penuba (6), Sinkep (33).

The local form of the *Mus surifer* group appears to be the most abundant and generally distributed member of its genus. Considerable variation is shown by the 127 specimens collected by Doctor Abbott; but taken as a whole the series from the Archipelago is noticeably less brightly colored than that from the Malay Peninsula. For measurements see table, page 267.

#### MUS near RATTUS.

Great Karimon (1), Sugi (2), Sugi Bawa (6), Batam (2), Kundur (1), Moro Kechil (11), Bakong (4).

Members of the *Mus rattus* group are very generally distributed throughout the Archipelago. The twelve skins collected by Doctor Abbott are all of the *alexandrinus* type of coloring, but the series are not sufficiently extensive to show whether more than one local form is represented. In the six skins from Sugi Bawa the belly is uniformly light buff, conspicuously paler than the dull yellowish-brown underparts of the two from Pulo Sugi. The four from Bakong are a peculiar slaty brown below. Two of the skins from Batam (male No. 142128 and male No. 142129) show no special peculiarities; underparts pale cream-buff. The third (male No. 142132) has much the same coloring as those from Sugi. The tail is, however, more finely annulated



than in any member of the group that I have seen, having about 16 rings to the centimeter near base. Both tail and ears of this specimen are imperfect. For measurements see table, page 267.

#### MUS FREMENS Miller.

1902. *Mus fremens* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 154, June 11, 1902.

A specimen was taken on Linga August 29, 1901, and another, the type, on Sinkep a week later. These are the only records from any of the islands of the Archipelago, though the animal occurs on the mainland of Sumatra as well as on certain islands off the west coast.<sup>a</sup>

#### MUS CONCOLOR Blyth.

Two specimens (adult female, No. 142126, and immature female, No. 142127) were taken at Semimba Bay, Batam, on September 20, 1905, by Mr. Kloss. For measurements see table, page 268.

#### Measurements of *Mus* from the Rhio-Linga Archipelago.

| Name.                        | Locality.             | Number.             | Sex.             | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot without claws. |
|------------------------------|-----------------------|---------------------|------------------|---------------|----------------|-----------------|------------|--------------------------|
|                              |                       |                     |                  | mm.           | mm.            | mm.             | mm.        | mm.                      |
| <i>Mus lingensis</i> ...     | Pulo Batam.....       | 142136              | Male adult ..... | 359           | 191            | 168             | 37         | 35                       |
| Do .....                     | do .....              | 142138              | do .....         | 338           | 179            | 159             | 36         | 33                       |
| Do .....                     | do .....              | 142135              | Female adult...  | 352           | 187            | 165             | 39         | 36.4                     |
| Do .....                     | do .....              | 142137              | do .....         | 311           | 166            | 145             | 37         | 34.6                     |
| Do ...                       | Pulo Bintang .....    | 115574              | do .....         | 397           | 223            | 174             | 40         | 38                       |
| Do .....                     | do .....              | 115575              | do .....         | 402           | 225            | 177             | 40         | 38                       |
| Do .....                     | do .....              | 115576              | do .....         | 371           | 212            | 159             | 39.6       | 37                       |
| Do .....                     | Pulo Moro Kechil..... | 122954              | Male adult ..... | 393           | 204            | 189             | 38         | 36                       |
| Do .....                     | do .....              | 122964              | do .....         | 277           | 205            | 172             | 38         | 35.6                     |
| Do .....                     | do .....              | 122965              | do .....         | 375           | 200            | 175             | 35.4       | 34                       |
| Do .....                     | do .....              | 122966              | do .....         | 359           | 189            | 170             | 38         | 36.4                     |
| Do .....                     | Pulo Bakong.....      | 123027              | do .....         | 378           | 215            | 163             | 42         | 39                       |
| Do .....                     | do .....              | 123031              | do .....         | 364           | 210            | 164             | 43         | 41                       |
| Do .....                     | do .....              | 123012              | Female adult...  | 345           | 200            | 145             | 38         | 35.4                     |
| Do .....                     | do .....              | 123019              | do .....         | 340           | 199            | 141             | 37.8       | 36                       |
| Do .....                     | do .....              | 123024              | do .....         | 323           | 188            | 135             | 38         | 36                       |
| Do .....                     | Pulo Sebang .....     | 123058              | do .....         | 377           | 215            | 162             | 38         | 35.6                     |
| Do .....                     | do .....              | 123066              | do .....         | 368           | 208            | 160             | 37.4       | 36                       |
| Do .....                     | Linga .....           | <sup>a</sup> 101614 | Male adult ..... | 387           | 216            | 171             | 42         | 40.4                     |
| Do .....                     | do .....              | 113044              | do .....         | 354           | 188            | 166             | 39.6       | 38                       |
| Do .....                     | do .....              | 113048              | do .....         | 389           | 219            | 170             | 42         | 40                       |
| Do .....                     | do .....              | 113049              | do .....         | 420           | 237            | 183             | 39.6       | 37.6                     |
| Do .....                     | do .....              | 113050              | do .....         | 383           | 201            | 182             | ...        | ...                      |
| Do .....                     | do .....              | 113040              | Female adult...  | 380           | 205            | 175             | 37.6       | 35.4                     |
| Do .....                     | Pula Penuba .....     | 123084              | Male adult ..... | 367           | 197            | 170             | 39         | 37                       |
| Do .....                     | Sinkep .....          | 113095              | do .....         | 365           | 199            | 166             | ...        | ...                      |
| Do .....                     | do .....              | 113090              | Female adult...  | 385           | 209            | 176             | 38.4       | 36                       |
| Do .....                     | do .....              | 113092              | do .....         | 384           | 213            | 171             | 41         | 39                       |
| Do .....                     | do .....              | 113093              | do .....         | ...           | 182            | 163             | 41         | 39                       |
| Do .....                     | do .....              | 113094              | do .....         | ...           | 204            | 176             | 40         | 39                       |
| <i>Mus near r. ultus</i> ... | Pulo Sugi .....       | 115552              | Male adult ..... | ...           | 201            | 186             | 37         | 35                       |
| Do .....                     | Pulo Sugi Bawa .....  | 115551              | Female adult...  | ...           | 174            | 164             | 34         | 32                       |
| Do .....                     | do .....              | 115553              | do .....         | ...           | 182            | 172             | 37         | 34.8                     |
| Do .....                     | do .....              | 115556              | do .....         | ...           | 187            | 182             | 36.6       | 34.4                     |
| Do .....                     | Pulo Kundur .....     | 122884              | do .....         | ...           | 197            | 192             | 37.4       | 36                       |
| Do .....                     | Pulo Bakong.....      | 123020              | Male adult ..... | ...           | 170            | 155             | 34.6       | 33                       |
| Do .....                     | do .....              | 123034              | do .....         | ...           | 165            | 167             | 33         | 31.4                     |
| Do .....                     | Pulo Batam .....      | 142128              | do .....         | 385           | 193            | 192             | 35         | 32.4                     |
| Do .....                     | do .....              | 142129              | do .....         | 375           | 180            | 195             | 34         | 31.6                     |
| Do .....                     | do .....              | 142132              | do .....         | ...           | 150            | ...             | 33         | 31.0                     |
| <i>Mus fremens</i> .....     | Linga .....           | 113046              | Female adult...  | ...           | 234            | ...             | 46         | 44                       |
| Do .....                     | Sinkep .....          | <sup>a</sup> 113087 | Male adult ..... | 558           | 234            | 324             | 47         | 44.6                     |

<sup>a</sup> Type.

<sup>a</sup> See Miller, Proc. U. S. Nat. Mus., XXVI, p. 463, February 3, 1903.

Measurements of *Mus* from the *Rhio-Linga Archipelago*—Continued.

| Name.                    | Locality.            | Number. | Sex.              | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot without claws. |
|--------------------------|----------------------|---------|-------------------|---------------|----------------|-----------------|------------|--------------------------|
|                          |                      |         |                   | mm.           | mm.            | mm.             | mm.        | mm.                      |
| <i>Mus concolor</i> .... | Pulo Batam .....     | 142126  | Female adult...   | 262           | 123            | 139             | 22         | 20                       |
| Do.....                  | do.....              | 142127  | Female, immature. | 224           | 109            | 115             | 22         | 20                       |
| <i>Mus firmus</i> .....  | Great Karimon .....  | 122820  | Male adult.....   | 505           | 250            | 255             | 50         | 47                       |
| Do.....                  | do.....              | 122838  | do.....           | 520           | 256            | 264             | 49         | 45                       |
| Do.....                  | do.....              | 122839  | do.....           | 471           | 234            | 237             | 47         | 43                       |
| Do.....                  | do.....              | 122821  | Female adult...   | 492           | 247            | 245             | 45         | 42                       |
| Do.....                  | do.....              | 122822  | do.....           | 504           | 247            | 257             | 45         | 42                       |
| Do.....                  | Pulo Sugi .....      | 115591  | Male adult .....  | 472           | 249            | 247             | 50         | 46                       |
| Do.....                  | do.....              | 115594  | do.....           | 472           | 225            | 247             | 49         | 45                       |
| Do.....                  | do.....              | 115596  | do.....           | 450           | 218            | 232             | 50         | 46                       |
| Do.....                  | do.....              | 115592  | Female adult...   | 492           | 245            | 247             | 49         | 46                       |
| Do.....                  | do.....              | 115595  | do.....           | 462           | 232            | 230             | 47         | 44                       |
| Do.....                  | Pulo Sugi Bawa ..... | 115590  | Male adult .....  | 520           | 264            | 256             | 50         | 46                       |
| Do.....                  | do.....              | 115589  | Female adult...   | 518           | 246            | 272             | 47         | 44                       |
| Do.....                  | do.....              | 115588  | do.....           | 487           | 230            | 257             | 47         | 44                       |
| Do.....                  | Pulo Sebang .....    | 123065  | Male adult .....  | 517           | 250            | 267             | 50         | 47                       |
| Do.....                  | Pulo Bakong .....    | 123021  | do.....           | 452           | 226            | 226             | 47         | 44                       |
| Do.....                  | do.....              | 123032  | do.....           | 450           | 230            | 220             | 47         | 44                       |
| Do.....                  | Linga .....          | 113035  | do.....           | 538           | 269            | 269             | 52         | 49                       |
| Do.....                  | do.....              | 113036  | Female adult...   | 488           | 234            | 254             | 48         | 44                       |
| Do.....                  | do.....              | 113038  | do.....           | 500           | 245            | 255             | 50         | 48.6                     |
| Do.....                  | do.....              | 113039  | do.....           | 490           | 230            | 260             | 48         | 44                       |
| <i>Mus tingensis</i> ..  | Great Karimon .....  | 122826  | Male adult .....  | 361           | 207            | 154             | 41.4       | 39.4                     |
| Do.....                  | do.....              | 122828  | do.....           | 359           | 201            | 158             | 40.4       | 38                       |
| Do.....                  | do.....              | 122825  | Female adult...   | 356           | 202            | 154             | 39         | 36                       |
| Do.....                  | Pulo Sugi .....      | 115569  | Male adult .....  | 426           | 234            | 192             | 43         | 41                       |
| Do.....                  | do.....              | 115572  | do.....           | 406           | 229            | 177             | 41         | 39                       |
| Do.....                  | Pulo Sugi Bawa ..... | 115568  | do.....           | 378           | 207            | 171             | 40.4       | 38                       |
| Do.....                  | do.....              | 115566  | do.....           | 359           | 191            | 168             | 39         | 36.6                     |
| Do.....                  | do.....              | 115571  | do.....           | 373           | 205            | 168             | 39         | 37                       |
| Do.....                  | do.....              | 115570  | Female adult...   | 360           | 200            | 160             | 38.6       | 36                       |
| Do.....                  | Pulo Bintang .....   | 115573  | Male adult .....  | 398           | 219            | 179             | 43         | 40.4                     |

α Type.

## Family VIVERRIDÆ.

## VIVERRA TANGALUNGA Gray.

1902. *Viverra tangalunga* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 156, June 11, 1902. (Linga.)

An adult female was trapped by Malays on Linga Island, August 27, 1901, and three others were taken on Bintang in 1902. These are the only specimens that Doctor Abbott has secured in the Archipelago. For measurements see table, page 271.

## ARCTOGALIDIA SIMPLEX Miller.

1902. *Arctogalidia simplex* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 156, June 11, 1902. (Linga.)

Three specimens are now known: The type, an adult male, taken August 30, 1901, on Linga, an immature male taken September 2, 1901, on Sinkep, and an adult female shot in a cocoanut plantation on the same island, August 7, 1903. The skins show no variations worthy of note. An adult female, of this or a closely related form, was taken on Batam, September 16, 1905, by Mr. Kloss. For measurements see table, page 271.

**ARCTOGALIDIA FUSCA, new species.**

*Type*.—Adult male (skin and skull), Cat. No. 122920, United States National Museum. Collected on Pulo Kundur, Rhio Archipelago, June 22, 1903, by Dr. W. L. Abbott. Original number, 2540.

*Characters*.—Size about as in *Arctogalidia simplex*, but color darker, and all three dorsal stripes well developed.

*Color*.—Type: General color above a rather dark smoke-gray or drab-gray, irregularly lightened by the narrow buffy gray subterminal annulations and silvery gloss of the hairs. On crown, ears, feet, and distal two-thirds of tail the color deepens to nearly black. Dorsal stripes blackish, the central clear and sharply defined, the laterals less distinct, though evident. Sides of neck washed with light ochraceous-buff. Underparts broccoli-brown washed with pale buffy, this color running out faintly on basal third of tail. Forehead with the usual whitish stripe.

*Skull and teeth*.—The skull and teeth do not differ appreciably from those of *Arctogalidia simplex*.

*Measurements*.—For external measurements see table, page 271. Skull of type: Greatest length, 98 mm.; upper length, 90; condylobasilar length, 93.8; basilar length, 89.4; palatilar length, 51.2; breadth of palate between anterior molars, 15; zygomatic breadth, 62; constriction in front of postorbital processes, 18; constriction behind postorbital processes, 17; breadth of braincase above roots of zygomata, 34.4; mandible, 73.4; maxillary toothrow (exclusive of incisors), 35; mandibular toothrow (exclusive of incisors), 37.

*Specimens examined*.—Four, all from Pulo Kundur. The skull of an adult female from Pulo Bintang (No. 115600, August 18, 1902) may represent the same species.

*Remarks*.—The Kundur *Arctogalidia* is fully as dark as the black-eared animals of Borneo and the Malay Peninsula, but is readily distinguishable by its smaller size. From the small members of the genus it differs in its dark color and well-developed dorsal stripes.

**PARADOXURUS BRUNNEIPES, new species.**

*Type*.—Adult male (skin and skull), Cat. No. 122886, United States National Museum. Collected on Pulo Kundur, Rhio Archipelago, June 24, 1903, by Dr. W. L. Abbott. Original number, 2549.

*Characters*.—In general like *Paradoxurus hermaphroditus* of the Malay Peninsula, but ground color of upper parts more yellowish, and feet dull brown instead of nearly black; skull with audital bullae noticeably reduced in size.

*Color*.—Type: Ground color throughout ochraceous-buff, dull and pale on back, brighter on under parts and base of tail, grayer on neck. Crown, ears, and area below and behind eyes dark hair brown; face

and cheeks dull, buffy gray; feet broccoli-brown, scarcely darker than legs; tail dull blackish on terminal half, except for a white ring 30 mm. wide, 80 mm. from tip; on basal half the black gradually gives place to the ochraceous-buff; dorsal markings normal, the clear black longitudinal stripes extending onto base of tail, where, however, they become broken up into spots. Beyond the lateral stripe a second band is indicated by a row of spots, and beyond this the sides are irregularly spotted, especially at shoulder and in front of thigh.

*Skull and teeth.*—Although similar in its structural details to that of *Paradoxurus hermaphroditus*, the skull is larger, the rostrum and palate are broader, the audital bullæ are distinctly smaller and less inflated. Teeth as in the related species, but larger throughout.

*Measurements.*—For external measurements see table, page 271. Skull of type: Greatest length, 114 (112)<sup>a</sup> mm.; upper length, 102.8 (98.6); condylobasilar length, 109 (109); basilar length, 102.6 (104); palatilar length, 49.6 (50); breadth of palate between anterior molars, 23 (21); breadth of rostrum through roots of canines, 23 (21); zygomatic breadth, 65.4 (65); constriction in front of postorbital processes 19.4 (18.8); constriction behind postorbital processes, 9.4 (12); breadth of braincase above roots of zygomatics, 32 (34); mandible, 84 (83); maxillary toothrow (exclusive of incisors), 42.4 (41); mandibular toothrow (exclusive of incisors), 48 (46.4).

*Specimens examined.*—Three, all from Pulo Kundur.

*Remarks.*—This species is readily distinguishable from *Paradoxurus hermaphroditus* by its brown feet, a character to which I find no approach in a series of about fifty specimens. The cranial characters may be of less importance, though the skull of the type can not be matched among numerous skulls of *P. hermaphroditus* collected by Doctor Abbott. The three skins show no variations worthy of special note.

### Family MUSTELIDÆ.

#### AONYX CINEREA (Illiger).

Two clawless otters have been taken in the Archipelago, an adult female shot among the mangroves on Great Karimon, May 28, 1903, and a young male (no. 123068) caught by natives off Pulo Sebang, July 31, 1903. Their measurements are, respectively: Head and body, 468 mm.; tail, 270; hind foot, 89; and head and body, 330; tail, 180; hind foot, 70.

<sup>a</sup>Measurements in parenthesis are those of an older male *P. hermaphroditus* from the Rumpin River, Pahang (no. 115487), the largest in an extensive series from the mainland.



*Measurements of Viverra, Arctogalidia, and Paradozurus from the Rhio-Linga Archipelago.*

| Name.                               | Locality.     | Num-ber.            | Sex.                | Total length. | Head and body. | Tail ver-bræ. | Hind foot. | Hind foot with-out claws |
|-------------------------------------|---------------|---------------------|---------------------|---------------|----------------|---------------|------------|--------------------------|
|                                     |               |                     |                     | mm.           | mm.            | mm.           | mm.        | mm.                      |
| <i>Viverra tangalunga</i> .....     | Linga .....   | 113067              | Female adult...     | .....         | 655            | 369           | 100        | 97                       |
| Do .....                            | Bintang ..... | 115597              | Male adult .....    | 990           | 675            | 315           | 101        | 96                       |
| Do .....                            | do .....      | 115598              | Male immature ..... | 850           | 580            | 270           | .....      | 90                       |
| Do .....                            | do .....      | 115599              | Female adult .....  | 983           | 658            | 325           | .....      | 95                       |
| <i>Arctogalidia simplex</i> .....   | Linga .....   | <sup>a</sup> 113069 | Male adult .....    | 1,050         | 515            | 535           | 83         | 80                       |
| Do .....                            | Sinkep .....  | 113144              | do .....            | 880           | 405            | 475           | 77         | 80                       |
| Do .....                            | do .....      | 123103              | Female adult .....  | 1,035         | 480            | 555           | 80         | 85                       |
| Do .....                            | Batam .....   | 142153              | do .....            | 950           | .....          | 502           | .....      | .....                    |
| <i>Arctogalidia fusca</i> .....     | Kundur .....  | <sup>a</sup> 122920 | Male adult .....    | 970           | 485            | 485           | 89         | 83                       |
| Do .....                            | do .....      | 122917              | do .....            | .....         | 515            | .....         | 86         | 82                       |
| Do .....                            | do .....      | 122918              | do .....            | 1,094         | 514            | 580           | 90         | 86                       |
| Do .....                            | do .....      | 122919              | do .....            | 1,045         | 490            | 555           | 91         | 86                       |
| <i>Paradozurus brunneipes</i> ..... | do .....      | <sup>a</sup> 122886 | do .....            | 1,004         | 554            | 450           | 91         | 87                       |
| Do .....                            | do .....      | 122885              | Female adult .....  | 925           | 525            | 400           | 85         | 80                       |
| Do .....                            | do .....      | 122887              | do .....            | 920           | 500            | 420           | 82         | 78                       |

<sup>a</sup> Type.

## Family TUPAIIDÆ.

## TUPAIA CASTANEA Miller.

1903. *Tupaia castanea* MILLER, Smithsonian Miscell. Coll., XLV, p. 54, November, 6, 1903.

The two original specimens of this species, collected on Pulo Bintang, August 9 and 11, 1902, are all that have thus far been taken. Both were shot in heavy forest. For measurements see table, page 272.

## TUPAIA TANA Raffles.

1822. *Tupaia tana* RAFFLES, Trans. Linn. Soc., London, XIII, p. 257. (Sumatra).

1900. *Tupaia tana* MILLER, Proc. Washington Acad. Sci., II, p. 229, August 20, 1900. (Linga.)

An adult male taken on Linga Island, July 16, 1899, is the only specimen known from the Archipelago. For measurements see table, page 272.

## TUPAIA PHÆURA Miller.

1902. *Tupaia phæura* MILLER, Proc. Acad. Nat. Sci., Philadelphia, p. 157, June 11, 1902.

Three were taken on Sinkep Island in 1901. The animal has not been met with elsewhere. For measurements see table, page 272.

## TUPAIA FERRUGINEA Raffles.

Two adult females (Nos. 142151 and 142152) were taken by Mr. Kloss at Semimba Bay, Batam, September 15 and 16, 1905. They are slightly larger than two collected by Doctor Abbott on Singapore Island (Nos. 111977 and 111979) in October, 1900, a difference especially noticeable in the molar teeth, but I can detect no appreciable peculiari-

ties in color except that the tail is slightly more gray. The material is not sufficient to show whether it is necessary to recognize the two forms by name. For measurements see table, page 272.

### TUPAIA MALACCANA Anderson.

1879. *Tupaia malaccana* ANDERSON, Anat. and Zool. Researches, Yunnan, p. 134, (Malacca.)

1900. *Tupaia malaccana* MILLER, Proc. Washington Acad. Sci., II, p. 230, August 20, 1900. (Linga.)

1902. *Tupaia malaccana* MILLER, Proc. Acad. Nat. Sci., Philadelphia, p. 157, June 11, 1902. (Linga and Sinkep.)

During his first visit to Linga Island Doctor Abbott obtained two adult males and an adult female of the Malacca treeshrew. A fourth specimen was taken on the same island in 1901. Two were procured on Sinkep in 1901 and four in 1903. On these two islands it is therefore apparently the commonest member of the genus. The skins show no specially noteworthy variations in color. For measurements see table, page 272.

#### Measurements of *Tupaia* from the Rhio-Linga Archipelago.

| Name.                          | Locality.     | Number.  | Sex.                   | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot without claws. |
|--------------------------------|---------------|----------|------------------------|---------------|----------------|-----------------|------------|--------------------------|
|                                |               |          |                        | mm.           | mm.            | mm.             | mm.        | mm.                      |
| <i>Tupaia castanea</i> .....   | Pulo Bintang. | 115607   | Male adult .....       | 360           | 210            | 150             | 46         | 44                       |
| Do .....                       | do .....      | α 115608 | Female adult .....     | 345           | 200            | 145             | 44         | 42                       |
| <i>Tupaia tana</i> .....       | Linga .....   | 101597   | Male adult .....       | 324           | 191            | 133             | 42         | 38                       |
| <i>Tupaia phæura</i> .....     | Sinkep .....  | α 113148 | do .....               | 335           | 195            | 140             | 46         | 43.6                     |
| Do .....                       | do .....      | 113147   | Female adult .....     | 325           | 195            | 140             | 43         | 40                       |
| Do .....                       | do .....      | 113149   | do .....               | 335           | 195            | 140             | 44         | 41                       |
| <i>Tupaia ferruginea</i> ..... | Batam .....   | 143151   | do .....               | 360           | 200            | 160             | 43         | 40                       |
| Do .....                       | do .....      | 143152   | do .....               | 334           | 180            | 154             | 41         | 38.6                     |
| <i>Tupaia malaccana</i> .....  | Linga .....   | 101598   | Male adult .....       | 298           | 133            | 165             | 34         | 32                       |
| Do .....                       | do .....      | 101600   | do .....               | 305           | 140            | 165             | 34         | 32                       |
| Do .....                       | do .....      | 113068   | do .....               | 297           | 141            | 156             | 36         | 33.6                     |
| Do .....                       | do .....      | 101599   | Female adult .....     | 305           | 140            | 165             | 35         | 33                       |
| Do .....                       | Sinkep .....  | 113145   | do .....               | 313           | 133            | 180             | 35         | 33                       |
| Do .....                       | do .....      | 113146   | do .....               | 290           | 130            | 160             | 35.6       | 33                       |
| Do .....                       | do .....      | 123104   | do .....               | 277           | 127            | 150             | 35         | 33                       |
| Do .....                       | do .....      | 123106   | do .....               | 290           | 130            | 160             | 36         | 34                       |
| Do .....                       | do .....      | 123107   | Female, immature ..... | 270           | 120            | 150             | 34.6       | 32.6                     |
| Do .....                       | do .....      | 123105   | Male adult .....       | 305           | 140            | 165             | 34         | 32                       |

α Type.

### Family COLUGIDÆ.<sup>a</sup>

#### CYNOCEPHALUS <sup>b</sup> VOLANS Linnæus.

Great Karimon (1), Bintang (6), Kundur (3), Bakong (1), Sebang (1), Penuba (3).

<sup>a</sup> See Miller, Proc. Biol. Soc. Washington, XIX, p. 41, February 26, 1906.

<sup>b</sup> 1768. *Cynocephalus* BODDAERT, Dierhundig, Mengelwerk, II, p. 8, Type, *C. rolans* from Ternate.

1780. *Galeopithecus* PALLAS, "Acta Acad. Sci. Imp. Petrop., IV, p. 208."

The flying lemur is common and generally distributed throughout the Archipelago. Among the fifteen specimens collected by Doctor Abbott there is some variation in size, though the series from the different islands are not extensive enough to show whether more than one local form is represented. For measurements see table, page 273.

*Measurements of Cynocephalus from the Rhio-Linga Archipelago.*

| Name.                         | Locality.         | Number. | Sex.             | Total length. | Head and body. | Tail vertebrae. | Hind foot. | Hind foot with-out claws. | Front foot. | Front foot with-out claws. |
|-------------------------------|-------------------|---------|------------------|---------------|----------------|-----------------|------------|---------------------------|-------------|----------------------------|
|                               |                   |         |                  | mm.           | mm.            | mm.             | mm.        | mm.                       | mm.         | mm.                        |
| <i>Cynocephalus volans</i> .. | Pulo Bintang...   | 115605  | Female adult.    | 720           | 425            | 295             | 78         | 67                        | 85          | 78                         |
| Do .....                      | Great Karimon.    | 122841  | .....do.....     | 633           | 403            | 230             | 69         | 62                        | 79          | 71                         |
| Do .....                      | Pulo Kundur...    | 122888  | .....do.....     | 657           | 407            | 250             | 72         | 65                        | 84          | 77                         |
| Do .....                      | .....do.....      | 122890  | .....do.....     | 657           | 407            | 250             | 74         | 68                        | 83          | 76                         |
| Do .....                      | Pulo Sebang ..... | 123069  | Male adult ..... | 374           | 192+           | 66              | 58         | 74                        | 68          |                            |
| Do .....                      | Pulo Bakong ..... | 123035  | .....do.....     | 560           | 345            | 215             | 65         | 57                        | 69          | 62                         |
| Do .....                      | Pulo Penuba ..... | 123086  | Female adult.    | 588           | 368            | 220             | 69         | 62                        | 76          | 69                         |
| Do .....                      | .....do.....      | 123087  | .....do.....     | 605           | 365            | 240             | 69         | 63                        | 72          | 65                         |
| Do .....                      | .....do.....      | 123088  | .....do.....     | 615           | 375            | 240             | 69         | 62                        | 73          | 67                         |

Family EMBALLONURIDÆ.

EMBALLONURA PENINSULARIS Miller.

This is the only insectivorous bat that has been collected in the Archipelago. Twenty were found roosting beneath a fallen tree in the forest at Pasir Panjang, Bintang, August 6, 1902, five were shot beneath an overhanging rock on Karimon Anak, June 3, 1903, and three were shot in caves on the shore of Pulo Sanglar on July 10, 1903. For measurements see table, p. 273.

*Measurements of Emballonura from the Rhio-Linga Archipelago.*

| Locality.          | Number. | Sex.               | Total length. | Tail. | Tibia. | Foot. | Forearm. | Thumb. | Second digit. | Third digit. | Fourth digit. | Fifth digit. | Ear from meatus. | Ear from crown. |
|--------------------|---------|--------------------|---------------|-------|--------|-------|----------|--------|---------------|--------------|---------------|--------------|------------------|-----------------|
|                    |         |                    | mm.           | mm.   | mm.    | mm.   | mm.      | mm.    | mm.           | mm.          | mm.           | mm.          | mm.              | mm.             |
| Pulo Bintang ...   | 115644  | Male adult .....   | 54            | 13    | 15     | 7     | 42       | 7      | 33            | 67           | 48            | 43           | 12               | 11              |
| Do .....           | 115645  | .....do.....       | 52            | 12    | 14.6   | 7     | 41       | 7.2    | 34            | 67           | 48            | 44           | 12.6             | 11              |
| Do .....           | 115648  | .....do.....       | 55            | 11    | 17     | 6.8   | 43.6     | 6.8    | 37            | 70           | 51            | 47           | 13.6             | 12              |
| Do .....           | 115649  | .....do.....       | 53            | 12    | 15.6   | 6.6   | 41.6     | 6.4    | 31.4          | 67           | 47            | 42           | 13               | 11              |
| Do .....           | 115650  | .....do.....       | 57            | 13    | 16     | 6.8   | 43       | 7.4    | 36            | 70           | 51            | 48           | 12.4             | 10.4            |
| Do .....           | 115652  | .....do.....       | 55            | 13    | 14.6   | 7     | 41       | 7      | 33            | 67           | 47            | 44           | 13               | 12              |
| Do .....           | 115655  | .....do.....       | 54            | 10.6  | 13.6   | 8     | 42       | 6      | 34            | 65           | 48            | 44           | 13               | 11              |
| Do .....           | 115658  | .....do.....       | 56            | 11    | 16     | 7.6   | 42.8     | 7.6    | 35            | 72           | 49            | 46           | 13               | 12              |
| Do .....           | 115660  | .....do.....       | 56            | 12    | 15     | 6.4   | 43       | 6.6    | 34            | 68           | 47            | 43           | 13               | 11.4            |
| Do .....           | 115661  | .....do.....       | 57            | 12    | 15     | 6.2   | 41       | 7      | 34.6          | 58           | 48            | 44           | 13.4             | 12              |
| Karimon Anak ..    | 122843  | .....do.....       | 52.4          | 11    | 16     | 7.2   | 42       | 7      | 36            | 65           | 48            | 43           | 10.4             | 9.4             |
| Do .....           | 122844  | Female adult ..... | 51            | 10    | 15     | 6.4   | 41       | 7      | 33            | 65           | 43            | 40           | 11               | 10              |
| Do .....           | 122846  | .....do.....       | 51            | 10    | 15     | 6.2   | 40       | 6.8    | 32            | 64           | 42            | 39           | 10.2             | 9               |
| Pulo Sanglar ..... | 122984  | .....do.....       | 54            | 11    | 15     | 7     | 42.4     | 7      | 34            | 64           | 43            | 42           | 11               | 10              |
| Do .....           | 122985  | Male adult .....   | 55            | 12    | 15.4   | 7     | 42       | 7      | 34            | 65           | 44            | 40           | 12               | 10.8            |
| Do .....           | 122986  | .....do.....       | 54            | 14    | 16.4   | 6.4   | 43       | 7.2    | 35            | 67           | 44            | 43           | 12               | 10              |

## Family PTEROPIDÆ.

## CYNOPTERUS MONTANOI Robin.

1881. *Cynopterus montanoi* ROBIN, Bull. Soc. Philomath. Paris, 7th ser., V, p. 90 (Malacca).

1901. *Cynopterus montanoi* MILLER, Proc. Washington Acad. Sci., III, p. 137, March 26, 1901.

Bats of this genus are evidently common throughout the Archipelago. They all appear to be referable to *Cynopterus montanoi*.

Measurements of *Cynopterus* from the Rhio-Linga Archipelago.

| Locality.        | Num-ber. | Sex.            | Total length. | Tail. | Tibia. | Foot. | Forearm. | Thumb. | Second digit. | Third digit. | Fourth digit. | Fifth digit. | Ear from meatus. | Ear from crown. |
|------------------|----------|-----------------|---------------|-------|--------|-------|----------|--------|---------------|--------------|---------------|--------------|------------------|-----------------|
|                  |          |                 | mm.           | mm.   | mm.    | mm.   | mm.      | mm.    | mm.           | mm.          | mm.           | mm.          | mm.              | mm.             |
| Pulo Sugi.....   | 115615   | Female adult... | 100           | 10    | 23     | 12    | 62.4     | 23     | 41            | 105          | 85            | 84           | 18               | 15              |
| Do.....          | 115616   | do.....         | 105           | 13    | 24     | 13    | .....    | 27     | 43            | 105          | 84            | 80           | 17               | 15              |
| Do.....          | 115617   | do.....         | .....         | ..... | 22     | 14    | 60       | 25     | 42            | 103          | 83            | 81           | 17.4             | 15.6            |
| Do.....          | 115623   | do.....         | 100           | 9     | 25     | 13    | 62       | 24     | 42            | 108          | 86            | 85           | 18               | 16              |
| Do.....          | 115626   | do.....         | 102           | 12    | 23     | 12    | 61       | 23     | 42            | 108          | 87            | 85           | 17               | 15              |
| Do.....          | 115628   | do.....         | 102           | 11    | 23     | 13.6  | 62       | 22     | 40            | 110          | 88            | 85           | 20               | 17              |
| Do.....          | 115629   | do.....         | 102           | 10    | 26     | 13    | 65       | 25     | 46            | 115          | 95            | 91           | 20               | 17              |
| Do.....          | 115632   | do.....         | 105           | 11    | 24     | 13    | 64       | 24     | 45            | 108          | 86            | 85           | 19               | 17              |
| Do.....          | 115633   | do.....         | 100           | 8     | 25     | 14    | 65       | 23     | 42            | 108          | 87            | 84           | 17.6             | 15.6            |
| Do.....          | 115634   | do.....         | 105           | 9     | 25     | 14    | 62       | 23     | 41            | 104          | 85            | 83           | 18               | 16.6            |
| Do.....          | 115635   | do.....         | 100           | 8     | 22     | 16    | 65       | 23     | 43            | 110          | 91            | 88           | 18               | 17              |
| Do.....          | 115636   | do.....         | 101           | 7     | 26     | 15    | 63       | 24     | 43            | 104          | 86            | 83           | 17               | 15              |
| Do.....          | 115637   | do.....         | 99            | 10    | 25     | 15    | 62       | 24     | 40            | 107          | 85            | 83           | 18               | 16              |
| Do.....          | 115638   | do.....         | 97            | 9.4   | 25.4   | 13    | .....    | 24     | 41            | 108          | 85            | 82           | 18               | 16              |
| Do.....          | 115639   | do.....         | 100           | 9     | 25     | 14    | 65       | 26     | 45            | 113          | 92            | 90           | 19               | 16              |
| Do.....          | 115640   | do.....         | 96            | 9     | 23     | 13    | 61       | 23     | 41            | 102          | 81            | 80           | 17               | 15              |
| Do.....          | 115641   | do.....         | 106           | 10    | 25     | 13    | 64.6     | 24     | 44            | 115          | 91            | 89           | 19               | 17              |
| Do.....          | 115642   | do.....         | 102           | 8.2   | 24     | 13    | 63       | 25     | 40            | 107          | 85            | 84           | 18               | 15.6            |
| Do.....          | 120714   | do.....         | 105           | 9     | 25     | 13    | 64       | 25     | 45            | 109          | 86            | 85           | 17               | 15              |
| Do.....          | 115627   | do.....         | 78            | 8     | 19     | 12.4  | 52.4     | 20     | 36            | 85           | 65            | 63           | 16.6             | 13              |
| Pulo Kundur....  | 122899   | Male adult...   | 88            | 10    | 24     | 13    | 62       | 25     | 42            | 99           | 72            | 78           | 17               | 15              |
| Do.....          | 122901   | Female adult... | 93            | 10    | 24     | 14    | 63       | 22     | 42            | 111          | 82            | 81           | 16               | 15              |
| Do.....          | 122905   | do.....         | 90            | 8     | 24     | 14    | 60       | 24     | 43            | 109          | 82            | 80           | 16               | 15              |
| Do.....          | 122906   | do.....         | 96            | 8     | 25     | 13    | 66       | 26     | 44            | 103          | 88            | 87           | 18               | 16.4            |
| Pulo Sanglar.... | 122981   | Male adult...   | 95            | 10    | 25     | 12    | 64       | 25     | 43            | 107          | 79            | 81           | 17               | 14.2            |
| Do.....          | 122982   | Female adult... | 98            | 8     | 24     | 13    | 62       | 23     | 43            | 102          | 81            | 81           | 17               | 14              |
| Do.....          | 122983   | do.....         | 103           | 8     | 24     | 13    | 62       | 23     | 40            | 101          | 79            | 80           | 16               | 14              |
| Pulo Penuba....  | 123090   | Male adult...   | 108           | 10    | 26     | 13    | 62       | 25     | 42            | 102          | 78            | 78           | 17               | 16              |
| Do.....          | 123092   | Female adult... | 93            | 94    | 25     | 14    | 64       | 26     | 44            | 99           | 83            | 81           | 17.4             | 14.4            |
| Do.....          | 123095   | do.....         | 100           | 9     | 26     | 13.4  | 67       | 26     | 44            | 107          | 85            | 83           | 19               | 17              |
| Do.....          | 123097   | do.....         | 103           | 10    | 25     | 12    | 63       | 25     | 41            | 103          | 79            | 78           | 15               | 14              |

## PTEROPUS VAMPIRUS (Linnæus).

1900. *Pteropus vampyrus* MILLER, Proc. Washington Acad. Sci., II, p. 237, August 20, 1900. (Linga.)

Eight specimens taken on Linga Island are the only ones procured by Doctor Abbott in the Archipelago.



*Measurements of Pteropus vampyrus from Linga Island.*

| Number. | Sex.                 | Head and body. | Foot. | Foot without claws. | Forearm. | Thumb. | Second finger. | Third finger. | Fourth finger. | Fifth finger. |
|---------|----------------------|----------------|-------|---------------------|----------|--------|----------------|---------------|----------------|---------------|
|         |                      | mm.            | mm.   | mm.                 | mm.      | mm.    | mm.            | mm.           | mm.            | mm.           |
| 101590  | Male adult.....      | 310            | 61    | 55                  | 200      | 77     | 155            | 370           | 295            | 263           |
| 101592  | Male immature.....   | 270            | 60    | 52                  | 165      | 75     | 127            | 308           | 247            | 217           |
| 101594  | Male adult.....      | 305            | 62    | 53                  | 192      | 83     | 143            | 342           | 277            | 242           |
| 101589  | Female adult.....    | 279            | 58    | 50                  | 193      | 80     | 144            | 342           | 270            | 250           |
| 101591  | Female immature..... | 260            | 58    | 50                  | 167      | 78     | 130            | 305           | 250            | 220           |
| 101593  | Female adult.....    | 305            | 63    | 58                  | 197      | 85     | 155            | 350           | 287            | 268           |
| 101596  | .....do.....         | 290            | 67    | 60                  | 190      | 80     | 148            | 340           | 280            | 245           |

## Family CERCOPITHECIDÆ.

## MACACA FASCICULARIS (Raffles).

Apparently common and generally distributed throughout the Archipelago. For measurements see table, page 276.

## PRESBYTIS CRISTATA (Raffles).

1900. *Semnopithecus maurus* MILLER, Proc. Washington Acad. Sci., II, p. 239, August 20, 1900. (Linga.)

Common throughout the Archipelago. The two skins from Pulo Sugi are rather darker than the others, as the silvery tips to the hairs are less conspicuous, but otherwise the series shows no special peculiarities. For measurements see table, page 276.

## PRESBYTIS RHIONIS Miller.

1903. *Presbytis rhionis* MILLER, Smithsonian Miscell. Coll., XLV, p. 64, November 6, 1903.

Common on Pulo Bintang, but thus far not known from any other locality. For measurements see table, page 276.

## PRESBYTIS CANA, new species.

*Type*.—Adult male (skin and skull), Cat. No. 122915, United States National Museum. Collected on Pulo Kundur, Rhio Archipelago, June 28, 1903, by Dr. W. L. Abbott. Original number, 2558.

*Characters*.—Similar to *Presbytis rhionis*, but larger and with conspicuously gray head.

*Color*.—The general color so closely resembles that of *Presbytis rhionis* as to require no detailed description. On the crown and forehead, however, the hairs are light gray from base nearly to tip, producing a distinct pale crown patch by which the animal is easily recognizable.

*Skull and teeth*.—The skull and teeth do not differ appreciably from those of *Presbytis rhionis*.

*Measurements.*—For external measurements see table, page 276. Skull of type: Greatest length, 89 (88)<sup>a</sup> mm.; condylobasilar length, 66 (64.6); basilar length, 58 (57); palatal length, 30 (28); palatal breadth between front molars, 19 (19); zygomatic breadth, 73 (68.8); mastoid breadth, 60.6 (60); breadth of brain case, 52.4 (50.4); postorbital constriction, 47.2 (44.8); interorbital constriction, 8 (6.8); least distance from orbit to alveolus of inner incisor, 19 (19.8); greatest depth of brain case, 42 (44); mandible, 65.2 (62); maxillary tooth row, exclusive of incisors, 28.4 (28); mandibular tooth row, exclusive of incisors, 32.4 (33.8).

*Specimens examined.*—Six from Pulo Kundur and two from near the mouth of the Kateman River, eastern Sumatra.

*Remarks.*—The six skins from Pulo Kundur show no important variations. All have the gray head markings well developed and the thigh patches large and conspicuous. In one female (No. 122911) the back is lighter than usual and the legs are browner, probably the result of bleaching. In the two from the Kateman River the thigh patches are somewhat reduced.

*Measurements of monkeys from the Rhio-Linga Archipelago.*

| Name.                            | Locality.          | Number.             | Sex.                 | Total length. | Head and body. | Tail vertebrae. | Foot. |
|----------------------------------|--------------------|---------------------|----------------------|---------------|----------------|-----------------|-------|
|                                  |                    |                     |                      | mm.           | mm.            | mm.             | mm.   |
| <i>Macaca fascicularis</i> ..... | Great Karimon..... | 122849              | Male adult.....      | 920           | 420            | 500             | ..... |
| Do.....                          | Pulo Bintang.....  | 115676              | .....do.....         | 1,010         | 485            | 525             | 122   |
| Do.....                          | .....do.....       | 115677              | .....do.....         | 928           | 445            | 483             | 128   |
| Do.....                          | Pulo Sugi.....     | 115675              | Female adult.....    | 942           | 420            | 522             | 112   |
| Do.....                          | Linga.....         | 111602              | Male immature.....   | 905           | 425            | 480             | 140   |
| Do.....                          | .....do.....       | 111603              | .....do.....         | 1,020         | 470            | 550             | 130   |
| <i>Presbytis cristata</i> .....  | Pulo Bintang.....  | 115670              | Male adult.....      | 1,130         | 475            | 655             | 147   |
| Do.....                          | .....do.....       | 115671              | .....do.....         | 1,225         | 550            | 675             | 142   |
| Do.....                          | .....do.....       | 115672              | Female adult.....    | 1,155         | 495            | 660             | 145   |
| Do.....                          | Pulo Sugi.....     | 115673              | .....do.....         | 1,157         | 502            | 655             | 142   |
| Do.....                          | .....do.....       | 115674              | .....do.....         | 1,247         | 530            | 717             | 150   |
| Do.....                          | Pulo Bakong.....   | 123036              | .....do.....         | 1,250         | 510            | 740             | 155   |
| Do.....                          | .....do.....       | 123037              | .....do.....         | 1,285         | 475            | 710             | 150   |
| Do.....                          | Pulo Setang.....   | 123070              | Female immature..... | 1,140         | 540            | 600             | 130   |
| Do.....                          | Linga.....         | 101601              | Female adult.....    | 1,275         | 535            | 740             | 145   |
| Do.....                          | .....do.....       | 113071              | .....do.....         | 1,255         | 515            | 740             | 145   |
| Do.....                          | .....do.....       | 113070              | Male adult.....      | 1,260         | 563            | 697             | 160   |
| <i>Presbytis rhionis</i> .....   | Pulo Bintang.....  | 115664              | Male immature.....   | 1,045         | 425            | 620             | 148   |
| Do.....                          | .....do.....       | 115666              | Male adult.....      | 1,213         | 550            | 663             | 150   |
| Do.....                          | .....do.....       | <sup>a</sup> 115665 | Female adult.....    | 1,173         | 468            | 705             | 150   |
| Do.....                          | .....do.....       | 115667              | .....do.....         | 1,135         | 470            | 665             | 158   |
| Do.....                          | .....do.....       | 115668              | .....do.....         | 1,090         | 460            | 630             | 148   |
| Do.....                          | .....do.....       | 115669              | Female immature..... | 965           | 360            | 605             | 135   |
| <i>Presbytis cana</i> .....      | Pulo Kundur.....   | 122912              | Male adult.....      | 1,110         | 470            | 640             | 155   |
| Do.....                          | .....do.....       | <sup>a</sup> 122915 | .....do.....         | 1,130         | 480            | 650             | 155   |
| Do.....                          | .....do.....       | 122911              | Female adult.....    | 1,170         | 455            | 715             | 152   |
| Do.....                          | .....do.....       | 122913              | .....do.....         | 1,165         | 470            | 715             | 157   |
| Do.....                          | .....do.....       | 122914              | .....do.....         | 1,153         | 493            | 660             | 154   |
| Do.....                          | .....do.....       | 122916              | .....do.....         | 1,225         | 485            | 740             | 158   |

<sup>a</sup> Type.

<sup>a</sup> Measurements in parentheses are those of an adult male *Presbytis rhionis* (No. 115666).

## GEOGRAPHICAL LISTS OF SPECIES.

In the following lists the species are arranged according to islands. The descriptions of the localities and the field observations are mostly from Doctor Abbott's letters, labels, and notebooks. For the spelling of the geographic names I have in most cases adopted that used by the collector; the variants are from Findlay's Indian Archipelago and China Sea Directory, Middel's Gids door Nederlandsch Oost-Indië, and from the standard maps.

GREAT KARIMON (*Karimon*).

The northwesternmost island of the Rhio Archipelago. It lies in the Strait of Malacca, 11 miles southwest of Tanjong Bulus, the south point of Asia. Its length is 10 miles and its area about 30 geographical square miles. The northern part of the island is hilly, the surface rising to 1,450 feet at Gunong Santan. Most of the low land has been cleared and is now grown up to lalang and scrub jungle. On the hills the original timber is mostly small, though there is some heavy forest at the north. Even here most of the best trees have been cut by the Chinese timber towkays from Singapore.

*Tragulus nigrocinctus*.—*Traguli* were scarce and hard to get. Those taken were snared by natives at Kampong Pernal and at Mensuda Bay.

*Sus rhionis*.—One was shot among the mangroves at Mensuda Bay.

*Ratufa carimonensis*.—Shot at Mensuda Bay.

*Sciurus carimonensis*.—Taken at Kampong Punkah on the east coast, and at Mensuda Bay, northeast corner of the island. These squirrels were very common in the plantations of fruit and cocoa.

*Mus firmus*.—

*Mus lingensis*.—

*Mus* near *rattus*.—The three rats are not specially mentioned in Doctor Abbott's notes.

*Aonyx cinerea*.—One shot among the mangroves at Mensuda Bay.

*Cynocephalus volans*.—No notes.

*Cynopterus montanoi*.—One shot while hanging on a palm leaf in dense jungle.

*Macaca fascicularis*.—Taken at Kampong Punkah. No notes.

LITTLE KARIMON (*Karimon Anak*).

Karimon Anak lies northwest of Karimon, separated from the larger island by a strait about one-half mile wide. It contains about 4 square miles, and is hilly; the surface mostly covered with heavy jungle.

*Sciurus peninsularis*.—No notes.

*Emballonura peninsularis*.—Shot beneath an overhanging rock in the forest.

Pigs, monkeys, and *Tragulus* exist, but none were obtained. A *Ratufa* is also said to occur.

KUNDUR (*Konduur*).

Pulo Kundur is not quite  $16\frac{1}{2}$  miles long—I do not remember the exact size—and contains about 90 square miles. It is about 6 miles from the nearest point on the coast of Sumatra, and about the same distance south of Karimon; between it and the latter there are, however, numerous small islets. Some islands to the north and separated by narrow channels from Kundur are given on the *older* charts as part of Kundur itself. Though much of its surface is low and swampy, especially along the coast, the interior is somewhat elevated, three of the hills rising to a height of 400 to 500 feet. Much of the interior has been cleared for the cultivation of gambier and pepper, and is now mostly covered with lalang and low scrub jungle. There are many sago plantations. The coast and lower portions of the island are still heavily forested. There is a total population of about 1,000—Chinese, Malays, and some Orang Utan and Orang Mantong; these last non-Mussulman wild tribes like the Jakuns.

*Tragulus nigrocinctus*.—Common. All the specimens taken were snared by natives. No small *Tragulus* occurs.

*Sus oi*.—

*Sus rhionis*.—Pigs swarmed in the sago plantations at night when I could not shoot, so I employed the wild men to get them. The Orang Mantong spear pigs in the following way: They make a screen of branches 10 or 15 feet long and 3 feet high near the stumps of newly felled sago palms which they know the pigs will visit at night. When they hear the animals at work they are able to come within striking distance behind the screens, as the pigs are very fond of sago and are easily approached while eating it. *Sus oi* was much less plentiful than the smaller animal. In addition to the female and young taken the men wounded a fine adult male, but their spears broke and the pig escaped.

*Ratufa condurensis*.—Shot in heavy forest, where they were quite numerous.

*Sciurus condurensis*.—No notes.

*Sciuropterus amœnus*.—No notes.

*Arctogalidia fusca*.—Those taken were shot in the tops of cocoanut palms.

*Paradoxurus brunneipes*.—No notes.

*Cynocephalus volans*.—No notes.

*Cynopterus montanoi*.—A dense bunch of about 20 hung to a cocoanut leaf in Kampong Batu. Of these 17 were killed at one shot.

*Presbytis cana*.—Common, but less so than *Macaca fascicularis*. One pair taken were mates. The female was shot first and the male came back and showed great anxiety, though all the rest of the drove fled in terror.



In addition to the mammals obtained in Kundur a large musang, probably *Viverra zangalunga*, was said to exist, also a *Minis*. The Orang Mantong said that the binturong (*Arctitis*) occurs. A *Funambulus* was once or twice seen, and I think I saw a *Nannosciurus*. *Macaca fascicularis* was very abundant.

## UNGAR.

Pulo Ungar lies along the southeast coast of Kundur, separated from it by a strait a quarter of a mile wide and 6 or 7 fathoms deep. Most of the surface is swampy, and great quantities of sago are grown. The central part of the island is slightly elevated, and is covered with alang-alang (long grass) and scrubby jungle. Wild pigs, especially *Sus rhionis*, are very plentiful. *Sus oi* is less common. Birds are numerous, but mammals are much fewer in species than on Kundur. Musangs (*Arctogalidia* or *Paradoxurus*) and *Tragulus* are said to exist. *Macaca fascicularis* is very numerous, and many are trapped and sent to Singapore for sale. There are no squirrels. Dugongs are said to be common, but none were seen.

*Sus rhionis*.—The pigs speared by natives were the only mammals procured on the island.

DURIAN (*Moro Besar, Durian Besar, Jora*).

This island lies on the east side of Durian Straits, a passage 5 to 8 miles wide, separating Karimon and Kundur from the more easterly island of the Rhio group. It contains 8 square miles, and is very hilly, its highest point 1,031 feet. Until recently it was covered with forest, but within a few years most of this has been cut off by Chinese to prepare the land for pepper and gambier cultivation. Some heavy forest remains on the hilltops, and there are patches of it in other places. Most of the surface, however, is now covered with scrubby jungle and alang-alang. Moro Besar is  $1\frac{1}{2}$  miles from Sugi Bawa, with the islands of Manda and Jan in the strait. It is 4 miles from Pulo Sugi and 19 from the nearest point of Sumatra.

*Mus firmus*.—

*Mus lingensis*.—No notes on either of the rats obtained.

I failed to get a large *Tragulus* which is said to exist. It was certainly very scarce, as the people could catch none, though they made plenty of traps and I offered \$2 apiece to stimulate their energies. *Sus rhionis* and *Macaca fascicularis* are both common. There are no squirrels.

JAN (*Djan*).

An islet in the strait between Moro Besar and Sugi Bawa, separated from the latter by only a narrow strait. This was not visited, but specimens of *Tragulus lutescens* were brought from it by natives while I was at Moro Besar.

MORO KECHIL (*Durian Kechil*, *Little Durian*).

July 6-9, 1903.

Moro Kechil is separated from Moro Besar by a strait one-fourth-mile wide containing 2 islets. Tidal currents run swiftly through the passage. The island is rocky and hilly, its highest point 571 feet. Surface covered with heavy forest of fine timber.

*Mus lingensis*.—No notes.

*Mus* near *rattus*.—No notes.

Rats of two species were the only mammals collected on Moro Kechil. As on Moro Besar, a large *Tragulus*, a pig (*Sus rhionis*), and a monkey (*Macaca fascicularis*) occur, though no specimens were procured. No squirrels exist. The Malays said there was one tiger on the island, but this must have been a Riman hantu (ghost tiger), as the island is small (2,000 acres) and there is no place such an animal could have come from. They never visit Kundur. Besides, no tracks could be found, and the only available food would have been wild pigs. Moro Kechil is uninhabited and is still covered with fine timber. It appears to be a ghost island, and the Malays are afraid to stay there. Every place swarms with spirits in Malayana, and if these happen to be bad, the locality is left unoccupied. It would quite delight a spiritualist.

SANGLAR (*False Durian*).<sup>a</sup>

July 10-11, 1903.

Pulo Sanglar contains about 2,000 acres and is hilly, the highest point 651 feet. Most of the surface has now been cleared by the Chinese, who have many pepper and gambier kebuns. This island lies about 3 miles south of Moro Besar.

*Sciurus peninsularis*.—Common; in very poor pelage.

*Emballonura peninsularis*.—Shot in caves on the shore.

*Cynopterus montanoi*.—Shot in cocoa palm.

There are no monkeys or *Tragulus*. Tengeling (*Manis*) are said to exist. Did not try trapping for rats. Pigs are common. The inhabitants, in addition to Chinese, are Orang Mantong and Orang Tambus.

SUGI BAWA (*Moro*).

August 31-September 2, 1902.

This island lies on the west side of Durian (Moro) Strait, directly north of Moro Besar, separated by a strait about a mile wide. It is 5½ miles long and about one-fourth as broad, containing 4,000 to 5,000 acres. The surface is hilly, the highest point about 500 feet. It is thinly inhabited and there are many old clearings, but a good deal of heavy forest still remains.

*Tragulus lutescens*.—Snared in jungle. Apparently common.

<sup>a</sup> Not shown on the map (facing page 247) where it should be placed; about the size of Jan. 2-3 mm. southeast of the southeast corner of Durian.

*Sus rhionis*.—No notes.

*Mus firmus*.—

*Mus* near *rattus*.—

*Mus lingensis*.—The three species of *Mus* were trapped in heavy jungle, where they were very abundant.

No musangs (*Viverridæ*) were seen, and the natives say that none occurs.

SUGI (*Soojee*).

August 22–29, 1902.

Pulo Sugi, on east side of Durian (Moro) Strait, is about 10 miles long and contains about 30 square miles. Scarcely any original forest remains, it having been cleared sometime since by Chinese to grow gambier. The surface is now mostly covered with scrub and blukar (secondary jungle), and there are wide areas of coarse bracken and lalang. Most of the island is hilly, rising to above 1,000 feet in Gunong Bekaka. A tract of heavy jungle lay about 2 miles W. S. W. of Nyor Kampong, and a hill with some original forest back (east) of Kampong Sisok furnished excellent collecting ground.

*Tragulus flavicollis*.—The napu was not common. Many traps and snares were seen, but the natives succeeded in getting only one specimen, though they were offered a dollar apiece for them.

*Ratufa insignis*.—Shot on a forest-covered hill. A number seen and heard.

*Sciurus peninsularis*.—Very common among the cocoanuts.

*Mus firmus*.—No notes.

*Mus lingensis*.—No notes.

*Mus* near *rattus*.—No notes.

*Cynocephalus montanoi*.—A large bunch hanging beneath a cocoanut leaf in village. Thirty-one killed at one shot; many of these young. Only one adult male in the lot.

*Macacus fascicularis*.—Common. Shot in patch of heavy forest.

*Presbytis cristata*.—Shot on forest-covered hill.

Pig tracks were plentiful, and Kubong (*Cynocephalus*) were said to exist. The natives said that there were no musangs on the island.

BATAM (*Battam*).

September 15–27, 1905.

Batam is the second largest of the *northern* islands of the Rhio Archipelago. It is the fourth in size of the whole group. It lies 10 miles southeast of Singapore, and is about 15 miles long by about 12 miles wide. Doctor Abbott has not visited it, but Mr. C. B. Kloss spent a week there in September, 1905. Part of his collection of mammals, numbering 30 specimens, has been presented to the U. S. National Museum. It contains the following species:

*Tragulus perflavus*.

*Sciurus peninsularis*.

*Mus lingensis*.

*Mus* near *rattus*.

*Mus concolor*.

*Arctogalidia simplex*?

*Tupaia ferruginea*.

Mr. Kloss writes that the monkeys of the island are *Presbytis cristata* and *Macaca fascicularis*, and also that a *Ratufa* occurs. He saw one *Sus oi*, but was unable to obtain it. This animal is, however, well known to be common on the island.

BINTANG.

August 5-20, 1902.

Pulo Bintang is the northeast island of the Rhio-Linga Archipelago. It is the largest of the group, containing about 325 square miles. It is 11 miles distant from the southeast point of the Malay Peninsula, and is separated from Batam by Rhio Strait. As Pulo Sau lies in this strait, the actual width of unbroken water is only about 2 miles. As the tide sets strongly through the strait, unassisted migration of wild mammals must be very rare. Originally covered with heavy forest, most of the land has been cleared for the cultivation of gambier, been exhausted, and is now covered with scrub and secondary jungle and broad patches of along grass.

*Tragulus formosus*.—Trapped by Malays at Telok Pemudong, on north shore of the island.

*Tragulus rubeus*.—Trapped at Telok Pemudong.

*Ratufa conspicua*.—Pretty common, but very hard to catch sight of.

*Sciurus peninsularis*.—Common. Shot among rocks on shore and also in heavy forest.

*Mus lingensis*.—Trapped in heavy jungle on rocky promontory by the shore.

*Viverra zangalunga*.—Trapped at Pasir Panjang. One bought from natives at Rhio was said to have been taken at the same locality.

*Arctogalidia* sp.—One shot and two others seen. The one taken was with another in a big kaju ara tree. They were making most remarkable cries like cats rutting, as these probably were.

*Tupaia castanea*.—A female contained 2 embryos.

*Cynocephalus volans*.—No notes.

*Emballonura peninsularis*.—Roosting beneath a fallen tree in the forest at Pasir Panjang. Twelve specimens were obtained with 3 shots from auxiliary barrel. There were probably 100 individuals in the colony. Five others were shot while roosting beneath a slanting rock in the forest.

*Macaca fascicularis*.—No notes.



*Presbytis cristata*.—The voice of *P. cristata* is a series of rather musical grunts, well represented by the Malay name Chingkau.

*Presbytis rhionis*.—Common. Malay name, Ka-Ka, from the cry, which is exactly similar to that of *P. femoralis* and *P. natunensis*.

The inhabitants of Bintang said there were 2 or 3 other musangs; one very big, probably *Viverra megaspila*, was rare; there was another, smaller; then the *tangalunga*, of which 2 were taken, and finally, the binturong, which they said was not common. Otter of 2 kinds were plentiful, and many tracks were seen. There were no wild-cats, except one lone tiger.

BAKONG (*Sechawa*).

July 15–22, 1903.

Pulo Bakong is a narrow island about 14 miles long and not much more than a mile wide. It lies north of Linga, from which it is separated by Dasi (or Dangsi) Strait, half a mile wide. Eastward lies a confused labyrinth of islands and islets. The tidal currents set strongly through the channels, which are 6 to 10 fathoms deep. The shores have fringing reefs, and there are many isolated coral patches. Bakong still contains some heavy timber, but most of it has been cut for the Singapore market. There are some tracts of lalang marking the sites of former cultivation. The hills rise to 200 or 300 feet.

*Tragulus pretiellus*.—All the *Traguli* obtained were trapped by natives and brought in alive. They were evidently very plentiful, as I had at last to refuse to buy any more and refused a good many. Some may have been caught on the islets off the shore of the main island. All the females were either pregnant or had recently had young. This, and the fact that some had been kept 24 hours without food before killing accounts for the variation in weight of the females.

*Mus firmus*.—No notes.

*Mus lingensis*.—No notes.

*Cynocephalus volans*.—No notes.

*Presbytis cristata*.—No notes.

Monkeys and pigs are common. Otter are said to be numerous. There are no squirrels or *Tupaia*.

PANAGA (*not shown on map*).

This is a small island off Bakong. It was not visited, but a *Tragulus* was brought from it on July 17, 1903.

SEBANG.

July 26–31, 1903.

Sebang is about 19 miles long by  $1\frac{1}{2}$  to 3 miles wide. It lies parallel to and about 6 miles east of Bakong. From Linga it is separated by a strait  $4\frac{1}{2}$  miles wide and 10 to 15 fathoms deep. The hills rise gen-

erally to a height of 200 to 400 feet. There was formerly considerable cultivation of gambier by the Chinese, but it is now given up, and there are many tracts covered with lalang and small scrub. There is still a good deal of heavy forest, but many of the best trees have been cut out and the remaining jungle is much mangled.

*Tragulus pretiellus*.—No notes.

*Sciurus peninsularis*.—

*Mus firmus*.—

*Mus lingensis*.—No notes on the rats or squirrel.

*Amyx cinerea*.—Caught by natives while swimming in the strait.

Tracks were common among the mangroves.

*Cynocephalus volans*.—No notes.

*Presbytis cristata*.—No notes.

Besides the mammals obtained, *Macaca fascicularis* was common, and some pigs were seen. Musangs were said to occur, but were rare. A wildcat said to exist; described as "blang," which means piebald, or dark and light in patches. The human inhabitants are Orang Laut and a few Chinese.

LINGA (*Lingga*, *Lingin*).

July 7-25, 1899, August 23-30, 1901.

Linga Island, lying about midway between Banka and Singapore Strait, is about 33 miles in extent, W. N. W. and E. S. E. From the nearest point, Point Baru (Datu), on the coast of Sumatra, the distance is about 35 miles. Upon its southwestern part is a remarkable mountain, the peak of which, rising to an elevation of 3,920 feet, is split in two, forming a sort of double peak, "rising like spires from the summit of the mountain," but more generally thought to resemble asses' ears, visible many miles in all directions. Viewed from the sea, this mountain presents a most beautiful and imposing appearance, which is sure to arrest the attention even of the most careless observer. Other hills rise to a height of from 600 to 750 feet. Heavy forests still are found on the island, and there is also the usual cultivation. (Account mostly from Findlay.)

*Tragulus pretiosus*.—

*Tragulus subrufus*.—Both species were abundant and were brought in by the natives in quantities, owing to the high price offered—\$1 (2 shillings) for napu and 50 cents for kanchil. The natives spoke of a larger species that was not obtained.

*Sus rhionis*?—Pigs were not uncommon, but the only specimen taken was a young female shot in a sago plantation at Mentuda Bay, on the west side of the island.

*Ratufa notabilis*.—Shot on a hillside covered with secondary jungle and some large trees. Breeding.

*Sciurus tenuis*.—No notes.

*Sciurus peninsularis*.—No notes.

*Rhinosciurus laticaudatus*.—Brought in by Malays, who secured it in a jerot or snare.

*Mus firmus*.—Trapped on the rocky promontory covered with forest, forming the north side of Mentuda Bay.

*Mus lingensis*.—No notes.

*Mus fremens*.—No notes.

*Viverra zangalunga*.—An adult female trapped by Malays, August 27, 1901. Uterus contained three embryos.

*Arctogalidia simplex*.—Shot in a "fig" tree in sago plantation. Said to be frequent in the cocoanut plantations.

*Tupaia tana*.—No notes.

*Tupaia malaccana*.—No notes.

*Tupaia phæura*.—No notes.

*Pteropus vampyrus*.—No notes.

*Macaca fascicularis*.—Two males were taken on July 23, 1899.

*Presbytis cristata*.—Shot from drove of 20 or 30 in sago plantation.

PENUBA (*Punoeba*, *Penoeba*).

August 2-6, 1903.

Pulo Penuba lies between Linga and Sinkep, from each of which it is separated by a strait about a mile wide. It is about 6 miles long and contains some 8,000 acres. The highest hill is about 950 feet. Considerable heavy timber remains, but the greater part of the island is covered with lalang and scrub. There are large plantations of cocoanuts.

*Sciurus peninsularis*.—Trapped in heavy forest near center of island.

*Mus lingensis*.—Trapped in heavy forest near center of island.

*Cynocephalus volans*.—Common among the cocoanuts.

*Cynopterus montanoi*.—No notes.

In addition to the mammals obtained, monkeys were plentiful, and tracks of pig and otter were numerous. Natives said that both large and small *Traguli*, tenggeling (*Manis*), and a large squirrel (*Ratufa*) occur.

SINKEP (*Singkep*, *Singkap*).

September 1-9, 1901, August 7-9, 1903.

This island with the smaller ones close to its shores covers a space of 200 to 240 square miles. Sinkep is of very irregular shape and of considerable elevation, having on its eastern side a range of hills, with a peak 1,440 feet high near the center of the range (Findlay). There appears to be nothing worthy of special note with regard to the vegetation of the island.

*Manis javanica*.—An adult female was dug from a burrow on a hillside by natives.

*Tragulus nigricollis*.—Only five were brought in by the natives. A few were seen in the jungle, but could not be shot.

*Tragulus subrufus*.—More numerous than the last.

*Ratufa confinis*.—Shot on a low hill by the seashore west of Sakana Bay. The hill is covered with heavy forest, with large trees, and the squirrels appeared plentiful.

*Sciurus peninsularis*.—Shot on the same hill with the *Ratufa*; plentiful.

*Nannosciurus pulcher*.—One taken at Sakana Bay in 1901 (no notes). At another locality they were found numerous in 1903. The voice is a very high-pitched, thin little whistle, kept up several minutes at a time, like the scolding of larger squirrels.

*Mus lingensis*.—

*Mus fremens*.—Both species of rats were trapped in heavy forest.

*Arctogalidia simplex*.—Shot in cocoanut plantation.

*Tupaia phæura*.—Trapped in heavy forest.

*Tupaia malaccana*.—This animal has a low, soft, birdlike whistle, and is much more arboreal than other *Tupaia*s.



## A REVIEW OF THE PÆCILIIDÆ OR KILLIFISHES OF JAPAN.

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By DAVID STARR JORDAN and JOHN OTTERBEIN SNYDER,

*Of Stanford University, California.*

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In this paper is given a review of the species of *Pæciliidæ* or *Cyprinodontidæ*, found in the waters of Japan. But two species are recorded, both fishes of very small size, living in pools and ditches in the rice swamps of southern Japan, and doubtless feeding on mosquitos. The specimens examined were collected by the authors during 1900. They are in the United States National Museum and in the museum of Stanford University.

### Family PÆCILIIDÆ.

Body oblong or moderately elongate, compressed behind, depressed forward, covered with rather large cycloid scales, which are adherent and regularly arranged. Lateral line wanting or represented by a few imperfect pores. Head scaly, at least above. Mouth terminal, small, the lower jaw usually projecting; margin of the upper jaw formed by the premaxillaries only; premaxillaries strong, extremely protractile. Teeth incisor-like or villiform, sometimes present on the vomer, but usually in the jaws only; lower pharyngeals separate, with cardiform or rarely molar teeth; third upper pharyngeal enlarged, the fourth wanting or united to the third. Gill membranes somewhat connected, free from isthmus; gill rakers very short, thick. Branchiostegals 4 to 6. Pseudobranchiæ none. Dorsal fin single, inserted posteriorly, of soft rays only, rarely with a single spine or a rudimentary spinous dorsal; caudal fin not forked; ventral fins abdominal, rarely wanting; pectoral fins inserted low; no adipose fin. Stomach siphonal, without pyloric appendages. Air bladder simple, often wanting. Basis cranii simple. Sexes usually unlike, the fins being largest in the male, but in some species the females are much larger in size. Many of the species are ovoviviparous, the young well developed at time of birth. In these species the sexes are very unlike, the anal fin of the male being

developed as an intromittent organ. Fresh-water fishes of southern Europe, Asia, Africa, and America, some of them occurring in bays and arms of the sea. They are mostly of small size, and the species are very difficult of determination. The species are known in Japan as *Medaka*.

## KEY TO GENERA.

- a. Intestinal canal comparatively short, little convoluted; teeth little movable; bones of the dentary firmly connected; the lower jaw strong and usually projecting beyond upper; species chiefly carnivorous.
- b. Anal fin of the male similar to that of the female and not modified into an intromittent organ. Species oviparous.
- c. Teeth all pointed, none of them compressed or bicuspid or tricuspid.

## FUNDULINÆ:

- d. Ventral fins well developed; pharyngeal bones and teeth not enlarged.
- e. Teeth in villiform bands or at least in more than one series; no teeth on vomer; jaws short.
- f. Anal fin short, of about 10 rays, inserted behind last ray of the short dorsal fin. FUNDULICHTHYS
- ff. Anal fin very long, of about 20 rays, inserted before first ray of dorsal fin. ORYZIAS

## FUNDULICHTHYS Bleeker.

*Fundulichthys* BLEEKER, *Conspectus Syst. Cyprinorum*, 1860, p. 439 (*virescens*).

This genus is imperfectly known. It appears to differ from the American genus or subgenus *Zygonectes* in having the small dorsal inserted wholly in advance of the equally small anal. According to the drawing of Bürger, published by Schlegel, the caudal fin is lunate. The single species is Japanese.

(*fundulus*, a related genus, *ιχθύς*, fish.)

## 1. FUNDULICHTHYS VIRESCENS (Schlegel).

OMEDAKA (large killifish), AKITABIRA (autumn minnow).

*Fundulus virescens* SCHLEGEL, *Fauna Japonica*, Poiss., 1846, p. 225, pl. cii, fig. 6.—

NAMIYE, *Class. Cat.*, 1883, p. 107 (Tokyo, Nagasaki).

*Fundulichthys virescens* ISHIKAWA and MATSU'URA, *Prel. Cat.*, 1897, p. 18 (Owari).—

JORDAN and SNYDER, *Check List*, 1901, p. 58.

*Habitat*.—Brooks of southern Japan.

Schlegel's description of this species is based solely on a drawing by Bürger. B. 4, D. 9, V. 7, P. 14, C. 18. Length of head equal to depth of trunk at pectorals, nearly one-fifth of total length. Jaws with many series of teeth, the median teeth largest. Eyes moderate. Scales of moderate size, the lateral line (rather a lateral streak of color), nearer back than belly. Vent nearer tip of caudal than tip of head. Dorsal fin in the middle of the back; it is small, as is also the anal. Caudal fin a little notched. Pectorals inserted below the angle of opercle.

Color in life olive green, darker on the back, paler on the sides, whitish below; dorsal, anal, and notably the caudal orange yellow.

Length a little more than 2 inches. Very common in the brooks and little rivers which flow into the bay of Nagasaki. (Schlegel.)

We did not find this species, and no one has described it since the time of Schlegel.

(*virescens*, greenish.)

### ORYZIAS Jordan and Snyder, new genus.

*Oryzias* JORDAN and SNYDER, new genus (*latipes*).

Body elliptical in form, compressed, covered with large scales; mouth small, with 2 rows of small, simple, pointed teeth; no teeth on vomer; gill opening not restricted above; intestinal canal short, about as long as body; peritoneum black. Dorsal fin short, inserted above middle of anal; anal *very long*, of 17 to 20 rays; caudal fin truncate. Sexes similar, except in color; anal fin not modified in the male.

This genus differs from *Aplocheilichthys* (= *Panchax*) of India in the short jaws and in the absence of teeth on the vomer. From *Zygonoectes* it is distinguished by the *very long* anal. The African genus *Aplocheilichthys* approaches it, but is sufficiently distinct. Rice fields of Japan.

(ὀρύζα, rice.)

Type of genus.—*Oryzias latipes*.

### 2. ORYZIAS LATIPES (Schlegel).

#### MEDAKA.

*Poecilia latipes* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 224, pl. cii, fig. 5 (Nagasaki).

*Aplocheilichthys latipes* BLEEKER, Art. Soc. Sci. Ind. Neerl., VII, Japan, p. 99 (Nagasaki).—JORDAN and SNYDER, Check List, 1901, p. 57 (Yokohama); Proc. U. S. Nat. Mus., XXIII, 1901, p. 530 (Tokyo).

*Haplocheilichthys latipes* GÜNTHER, Cat. Fish, VI, 1866 p. 311, (Nagasaki).—ISHIKAWA and MATSU'URA, Prel. Cat., 1897, p. 18 (Tokyo).

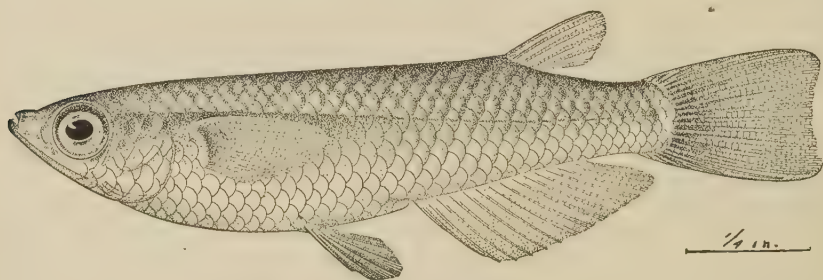
*Habitat*.—Rice fields and pools of Japan, north to Tokyo.

Head  $3\frac{1}{2}$  in length to base of caudal; depth  $3\frac{1}{2}$ ; depth of caudal peduncle  $7\frac{1}{2}$ ; eye  $2\frac{1}{2}$  in head; snout 4; interorbital space  $2\frac{2}{3}$ ; D. 6; A. 17; scales in lateral series 31.

Eye very large, interorbital space flat, snout short, lower jaw slightly projecting. Gill openings not restricted above by membrane, the opening extending to upper edge of pectoral. Branchiostegals 5. Gill rakers on first arch 13, short and rather blunt. Jaws with 2 rows of simple, pointed teeth, those in posterior row minute and difficult to detect; vomer smooth; pharyngeals with minute teeth, mostly arranged in 12 or 13 transverse rows above, 6 or 7 below. Intestinal canal about equal to length of body. Peritoneum dense black within, the outer surface next to the body wall bright silvery. Top and sides of head, throat, and chin naked; lateral line absent. Dorsal fin short, its origin above middle of anal; its height equal to or greater than

distance between tip of snout and posterior border of eye, the depressed fin usually falling short of base of anal, in some cases reaching it. Anal base very long, the posterior rays highest, about equal in height to those of dorsal, extending to base of caudal when depressed. Pectorals inserted partly below median line of body, their length contained about  $4\frac{1}{3}$  times in body. Ventrals pointed, short, just reaching vent when depressed. Caudal truncate,  $4\frac{1}{2}$  in the length.

Color in alcohol, light brownish, the silvery coating of peritoneum showing through walls of abdomen; a narrow, median, dusky stripe extending along back from occiput to dorsal; sides of body sparsely stippled with black, the edges of scales dusky; a median, dusky line extending along sides of body from tip of pectoral to base of caudal; membranes of fins dusky, the color deepening toward the edges; ventrals black; a narrow light area on base of caudal.



ORYZIAS LATIPES.

The above description is of a male example. The female has a more slender body, especially in the region posterior to anal opening; the anal is lower and the ventrals are usually longer, often reaching beyond base of anal. The ventrals are immaculate or only slightly dusky. No modification of the anal rays appears to distinguish either sex.

Many specimens were secured from a stagnant pool at Wakanoura, and an equal number from a ditch in a rice field at Kawatana, on the bay of Omura, to the northward of Nagasaki, in company with the minnow *Rhodeus oryzae*. Specimens were also received from Prof. Keinosuke Otaki from pools or brooks near Tokyo.

It is very common in all mosquito-breeding waters in southern Japan. (*latus*, broad; *pes*, foot.)



THE DIGGER WASPS OF NORTH AMERICA AND THE  
WEST INDIES BELONGING TO THE SUBFAMILY  
CHLORIONINÆ.

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By HENRY T. FERNALD,

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INTRODUCTION.

The studies contained in this paper have been based upon the extensive collections of the United States National Museum, supplemented by the almost equally large collections of the American Entomological Society in Philadelphia. In addition to these the collections of the Museum of Comparative Zoology of Harvard University in Cambridge, the Carnegie Museum in Pittsburg, American Museum of Natural History in New York, and those of Cornell University, besides a large number of smaller collections from all parts of North and South America and the West Indies have been carefully examined, a total of several thousand specimens in all. All the types existing in this country, so far as known, have been studied, and detailed descriptions prepared directly from them, modified or added to by the study of other specimens of the same species.

All work on the Chlorioninæ must be based upon the admirable paper *Die Hymenopterengruppe der Sphecinen*, by Fr. Friedrich Kohl, published in Vienna in 1890. This magnificent work leaves little to be desired for the Chlorioninæ of the Old World, but for American forms it is hardly satisfactory, as Doctor Kohl was unable to see most of the American types, and their descriptions are usually quite inadequate. The result has been the redescription of many American forms and incomplete data of distribution for many more. Notwithstanding this, the present paper can hardly claim to be more than a supplement to the above-named work, intended to accomplish for American species what that paper has done for those of Europe and the East. Even the analytical keys are in many parts only modifications of Kohl's, and his kindly assistance has frequently been invoked and always granted.

So many persons have been of great assistance during the preparation of this paper that it would be impossible to mention them all, but

besides Doctor Kohl in Vienna, I am deeply indebted to Dr. R. Rathbun, assistant secretary of the Smithsonian Institution; and to Dr. L. O. Howard, of the U. S. Department of Agriculture; Dr. W. H. Ashmead, of the National Museum; to Dr. Henry Skinner, of the American Entomological Society, for the loan of material from the collection at Philadelphia; to Mr. Samuel Henshaw, of Harvard College; Mr. William Beutenmüller, of the American Museum of Natural History; Dr. W. J. Holland, of the Carnegie Museum; Prof. J. H. Comstock, of Cornell University; and Sir Daniel Morris, of Barbados, for the loan of material in their charge, besides nearly thirty other persons who have in a similar way aided me in bringing together for study the largest accumulation of insects of this group ever made in this country.

At the time the work was begun it was proposed to limit its scope to the United States. It soon became evident, however, that it would be necessary to include Mexico and the West Indies, and the discovery of species in Arizona not heretofore reported north of Venezuela has led to the study of Central and South American forms also. The intention in this paper now is to include all the Chlorioninae known to occur in North America to the Isthmus of Panama and the West Indies, though the South American forms may perhaps be treated subsequently. It is the hope of the writer to be able to extend his studies to the Sceliphroninae and to the Sphecinae (Ammophilinae of authors) though such study as he has given to this last group has shown that its present condition is anything but encouraging for systematic work.

#### CLASSIFICATION AND NOMENCLATURE.

For some years the classification of the wasps has been the subject of many differences of opinion, the term Sphegoidea, as used by Ashmead, having been considered by some writers as including a number of families, while others have regarded it as containing but one.

The main differences of these views may be found in Doctor Ashmead's paper,<sup>a</sup> so that it is unnecessary to consider them here. The studies of the writer, however, have led him to an opinion somewhat different from any of those there given so far as the value of the minor groups is concerned.

The different species included in this paper, for the most part, fall without difficulty into one or another of six groups recognized by Ashmead as genera. In some cases, however, species are met with which are intermediate in character, linking different groups together in such a way that it becomes difficult to characterize them without making many exceptions, though in any two of these there are forms which differ widely from each other. This is very suggestive of the idea that the individuals of an old genus are now beginning to diverge in different directions, and that the result will ultimately be the for-

<sup>a</sup>Canadian Entomologist, XXXI, p. 145 *et seq.*

mation of several new genera among the descendants of the original one. But while connecting links between these groups are still in existence it would hardly seem safe to rate these groups as full-fledged genera, and for the present they should be regarded as of only subgeneric rank. For this reason the groups termed genera by Ashmead are here regarded as subgenera included in the genus *Sphex*, the only genus of the subfamily Sphecinae.

The genus *Sphex* was established by Linnæus in 1758, with twenty-five species. With the advance of entomological knowledge it soon became evident that many of these species had no close relationship, and they have gradually been withdrawn from *Sphex* and placed elsewhere. In fact this has been too well done, for at the end of the year 1805 not one of the original species of the genus was left, but instead an accumulation of other insects had been substituted, none of which had any right to be there according to the rules of nomenclature.

During the latter part of the eighteenth century, then, the genus *Sphex* was suffering from too much addition and subtraction, and the final result was that during almost the whole of the nineteenth century the name *Sphex* was applied to a group of insects not one of which was the same or even as much as congeneric with any of the species for which the genus was established.

From this it is evident that *Sphex*, as the name has been used during the last century, does not apply to the insects Linnæus intended—a condition in direct violation of that part of Rule 30 of the International Code of Zoological Nomenclature which says: "In no case, however, can the name of the original genus be transferred to a group containing none of the species originally included in the genus; nor can a species be selected as type which was not originally included in the genus." Consequently not only must the insects generally called *Sphex* during the past century give up this generic name, but some one of the original twenty-five described as *Sphex* must now resume it, together with all species with which it is congeneric.

In selecting the type of the genus *Sphex* as the next step which must follow we are no longer guided by any laws, but only by recommendations of the Code. As these represent a weighty consensus of opinion, however, it would seem desirable to follow them, if possible. The first and second recommendations under Rule 30 do not have any application in this case. The third directs, first, the exclusion from consideration of all species exotic from the standpoint of the author. This would leave eighteen species as possible types. The recommendation, then, is to reject "all species which have already been transferred to other genera. The type is then selected from the species which remain." In the present case, unfortunately, no species remain, all having been transferred to other genera; but if this method were to be applied and the last species (*pectinipes*) thus eliminated were to be

restored, the consequence would be that *Sphex* would replace *Tachysphex* as a genus of the Larridæ, and the terms Sphecinae, Sphecidae, and probably Sphegoidea as well would have to be abandoned.

As selection of the type by elimination would in the present case therefore produce great confusion not only in the group immediately concerned but in the Larridæ as well, it seems desirable to turn to the fourth recommendation of the Code, which is to "select as type the species which is best described, best figured, or best known." On this basis of selection only two of the species given by Linnæus in 1758 need consideration, namely, *sabulosa* and *spirifex*. Of these, the latter is omitted by Linnæus from his Fauna Suecica, indicating that his familiarity with it was not as great as with *sabulosa*, which is included in that work. That *sabulosa* is also in general the best known is indicated by the fact that in Dalla Torre's Catalogue there are 115 references to that species, and only 59 to *spirifex*. If page precedence be given any weight in the selection of the type, *sabulosa* should be chosen, as it precedes *spirifex*; while those who regard the first species of the genus as the type would here either have to make the type *argillacea* from Surinam, a species which has not since been recognized, thus removing *Sphex* as a generic name together with its subfamily and family compounds from use until *argillacea* is rediscovered, or, rejecting this, take the second species—*sabulosa* again—as the type.

Following the literature on *Sphex* down to the nineteenth century we find that almost every writer on the group recognized *sabulosa* as a *Sphex*, wherever he might place the other species, and that even after Kirby had placed it in *Ammophila*, in 1798, this change was only very slowly adopted, as a new group of species grew up around the genus *Sphex*.

For these reasons then, it seems best to regard *sabulosa* as the type of the genus *Sphex* and allow *Ammophila* to sink into synonymy together with the subfamily Ammophilinae.

In this way the names *Sphex*, Sphecinae, and Sphecidae may be saved for use in this group though applying to a different subdivision, but the insects hitherto called *Sphex* must receive another name. For this purpose the oldest subgenus, *Chlorion*, first proposed as generic in value, may be raised again to that grade and also form the basis for the new subfamily name Chlorioninae, which replaces the Sphecinae in this place. A new name for the former subgenus *Sphex* is also needed, and for this (no synonyms existing) the writer<sup>a</sup> has proposed the term *Proterosphex* (from πρότερος older, σφήξ wasp) suggesting the name used for these insects during the last century.

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<sup>a</sup>Entomological News, June, 1905.



The following tables, showing these changes, may be of assistance in this connection:

## PRESENT ARRANGEMENT.

| Family.         | Subfamilies.                 | Genera.                         | Subgenera. |
|-----------------|------------------------------|---------------------------------|------------|
| Sphecidae ----- | Sphecinae.                   | { Sphex.                        | Chlorion.  |
|                 | Sceliphroninae.<br>Podiinae. |                                 | Palmodes.  |
|                 | Ammophilinae.                | { Ammophila.<br>   Psammophila. | Priononyx. |
|                 |                              |                                 | Sphex.     |
|                 |                              |                                 | Isodontia. |

## NEW ARRANGEMENT.

| Family.         | Subfamilies.                 | Genera.                     | Subgenera.   |
|-----------------|------------------------------|-----------------------------|--------------|
| Sphecidae ----- | Chlorioninae.                | { Chlorion.                 | Chlorion.    |
|                 | Sceliphroninae.<br>Podiinae. |                             | Palmodes.    |
|                 | Sphecinae.                   | { Sphex.<br>   Psammophila. | Priononyx.   |
|                 |                              |                             | ProterospheX |
|                 |                              |                             | Isodontia.   |

The genitive of *Sphex* being *Sphecos* instead of *Sphegis* it follows that the subfamily and family names should be Sphecinae and Sphecidae, respectively.

## GENERAL CHARACTERS.

The insects of the subfamily Chlorioninae found in North America and the West Indies, are of moderate or small size, ranging from about half an inch to an inch and a half in length. Generally speaking, they have rather robust bodies, large wings, and long legs. The surface of the body is rarely entirely smooth. Usually the plates of which it is composed bear punctures, varying in size and in their nearness to each other. Closely correlated with the character of these punctures is the clothing of the body, and examination of the surface shows that the punctures are the places of origin of the hairs which form the clothing. The finest punctures are almost or quite microscopic, close together, and the hairs arising from them are exceedingly minute, short, decumbent, and give a sort of silky sheen to the surface. I have used the word "sericeous" to indicate this condition in the descriptive portion of this paper. Somewhat coarser punctures and correspondingly coarser hairs produce such an appearance as is found on the posterior side of the hind tibiae throughout this group. Still slightly coarser punctures and a clothing which consists of short decumbent hairs placed close together constitutes the next step, and I have used the term "pubescent" to express this condition, which occurs

with some exceptions on the clypeus in these insects. Still coarser punctures are the places of origin of coarser hairs, or of hairs perhaps little coarser than those forming pubescence, but standing erect and not so close to each other but that the nature and color of the plate beneath can be seen. These hairs seem in most cases to reach their greatest size on the clypeus, particularly in *Proterosphaer*, where they are almost bristles, erect, but with their outer portions bent downward. At different places on the body they vary in length and abundance, being longest usually behind the lower part of the eyes, and on the end and sides of the median segment.

Besides punctures, the surface of the body frequently shows parallel ridges or grooves, varying from fine to coarse. Whether they are ridges above the general surface of the plate or grooves in it, it is often difficult or impossible to determine. When in doubt the terms "striate," "striæ," or "rugose" have been used. Where these markings occur the punctures are usually in rows between them rather than on the ridges. Occasionally, particularly on the mandibles, elongated punctures resembling short grooves are found, either scattered or more or less in rows. These are termed "aciculations."

The colors present are limited, but the shades are numerous and perplexing. Black, ferruginous, and yellow are the leading colors, with every intermediate shade present in one or another species. The head and thorax are usually the location of the black, if present, while the abdomen may be partly black, partly ferruginous, entirely ferruginous, or even entirely yellow. The ferruginous is very variable in shade, ranging from a dark rich color resembling that of clear pieces of resin through lighter shades to a clear yellow. Where the thorax is black the legs and petiole tend to be black also, and in the case of the former when this fails the basal segments at least (coxae, trochanters, and bases of the femora) are liable to be black, as are the tips of the claws, while the mandibles are usually black, though it is not unusual, particularly in species having more or less ferruginous on the body, to find a band of this color on the mandibles also.

The wings, frequently hyaline, sometimes have a yellow tinge, particularly on the basal half. The outer margin is often darker, as though somewhat smoky or fuliginous, and in many cases the entire wing is fuliginous, and may even be so densely so as to be nearly opaque. Accompanying this increase of the fuliginous is an increase in a reflection color seen at certain angles. In North American forms this is usually blue or violet, but in many South American species it is distinctly greenish.

Pubescence is generally yellow and often golden, almost metallic in its luster. If not yellow it is white, more or less silvery. A sericeous surface may be dull black, brown, gray, yellowish, whitish, etc., according to the color of the minute hairs causing it, and a covering of this nature often conceals the color of the chitinous plate beneath.

## EXTERNAL ANATOMY.

*Head*.—The hypognathous head is large, broader than long, giving it a transverse oval or somewhat quadrangular outline when viewed from above. The compound eyes are large and extend from the top of the head almost to the base of the mandibles. Viewed from in front they form nearly half of the width of the head, while from the side they occupy a greater proportion, the cheek which lies behind the eye being at its widest place rarely more than half the width of the eye. The anterior and lateral margins of the eye are quite straight, but in *Proterospheæ* this organ near the top extends toward the middle of the head somewhat, so that the two eyes are nearer each other at the vertex than a little lower down. In some species the two eyes converge somewhat below, particularly in the males, till their distance apart near the middle of the clypeus is less than on a line drawn through the posterior ocelli. (Plate VI, fig. 1.)

The clypeus occupies the lower portion of the front of the head between the compound eyes and extends upward nearly to the antennæ. Its form differs in the different subgenera, but is more or less triangular, the truncated apex being above. It is somewhat convex and extends to varying distances below the eyes in different species. The outline of its anterior edge also varies and is made use of in the determination of the subgenera. (Plate X, figs. 22–26.)

On each side of the clypeus is a wedge-shaped extension downward from the frons, separating the upper part of the clypeus from the compound eye. The dorsal edge of the clypeus is indicated by a transverse suture a short distance below the insertion of the antennæ. In some cases the lateral sutures are continued upward as grooves of the frons which converge and meet between the antennæ leaving a triangle above the truncated apex of the clypeus, which when the suture between it and the clypeus is not pronounced seems to be a part of the latter plate. From the junction of these two grooves between the antennæ a median groove (the frontal suture) extends toward the vertex to the median ocellus where it divides, a branch passing lateral to the ocellus on each side. Behind the ocelli a transverse groove connecting these branches is sometimes perceptible, thus inclosing the ocelli in a triangular area. Sometimes, also, traces of the frontal suture may be found behind the median ocellus and between and even behind the lateral ocelli.

The frons then may be regarded as extending upward from the clypeus to the ocelli, with a downward extension on each side of the former, and an upward extension on each side of the latter. Near the frontal suture, close together, and a short distance above the clypeus are the antennal insertions. The frons as a whole is usually sunken below the level of the eyes and clypeus, giving the front of the head as viewed from above a somewhat excavated appearance.

The ocelli are three in number, arranged to mark the corners of a triangle, the anterior and median being the larger of the three, while the others are posterior and lateral. The distance apart of the lateral ocelli as compared with that between one of them and the compound eye is often useful in the determination of species. Behind the ocellar triangle there is sometimes a transverse oval area slightly raised above the surrounding surface and perhaps marking the real vertex of the head. In this paper the vertex is considered as being on a line drawn through the posterior ocelli. No sutures separating the vertex from the posterior portion of the head above or from the cheeks at the sides behind the eyes are present, and the limits of these parts are therefore somewhat indefinite.

The portion of the head showing behind the compound eye is termed the cheek in this paper. Its width and fullness vary greatly. When full it gives to the head, as viewed from above, an almost quadrangular outline with rounded corners; when retreating the eyes also seem less full, giving to the head a more oval outline. The width of the cheeks is usually greatest a short distance below the top of the eye. Below this point they may narrow rapidly or remain quite broad for some distance, narrowing suddenly nearly at the level of the bases of the mandibles.

The labrum is attached to the lower inner edge of the clypeus, leaving the outer edge of the latter well defined. In preserved specimens it is usually bent backward nearly at right angles to the clypeus and with the mandibles closed together over it so that it is not accessible for study. For this reason it has not seemed best to make use of the characters it possesses for analytical purposes, though studies of its structure indicate that in some cases distinctive features may be found there.

None of the mouth parts save the mandibles seem to be useful for the determination of species and their description, therefore, it is not included here.

The mandibles vary considerably within the limits of the group. Ordinarily they are quite long, somewhat curved, stout and decidedly rapacious in appearance, each reaching the base of the other when the jaws are closed. The mandible may be considered as consisting of a shank, a terminal tooth, and one, two, or three teeth on the inner or upper face, these last being much shorter than the terminal one in most cases. The proportions of the teeth to each other vary greatly, however, not only in different species but even in the same individual at different ages, the digging, which the mandibles are used for, often wearing them down to mere stubs. The posterior face and under (outer) surface are smooth so far as teeth are concerned but particularly on the anterior surface grooves or rows of indentations, termed



here aciculations, are often present, and on the upper and lower (inner and outer) borders a row of quite long, stiff hairs is often seen.

The antennæ are quite long and are usually carried in a somewhat curled position. The basal portion or bulb of the proximal segment or scape is very small and articulates with the head in a socket. Its diameter at this end is about equal to its length to where it unites with the enlarged portion of the scape, but it narrows rapidly till, at the point where it enlarges into the scape proper, its diameter is but little more than half that at the base, the narrowing being mainly on one side. The bulb has every appearance of being an entire segment, but as this is not the generally accepted view it is here considered as a part of the scape. The scape is the stoutest portion of the antenna. It is often ferruginous or partly so, when the remainder of the antenna is entirely black. Smallest at its base it enlarges rapidly and suddenly constricts close to its articulation with the next segment, the pedicel, the increase in diameter, as in the case of the bulb, being chiefly on one side. It generally bears a number of hairs, most abundant internally, which may in some cases be even so coarse as to almost entitle them to be termed spines. The pedicel which articulates with the scape proximally and the first segment of the filament distally is a short, subglobular segment, sometimes differing with the scape in color, from the remainder of the antenna, though more frequently of the same color as the filament. It also frequently bears numerous small hairs most abundant on the inner face. Kohl appears to consider the pedicel as the first segment of the filament. The filament consists of ten segments in the females and eleven in the males. These segments are generally longest proximally, being there two or three times as long as broad, and the first one is usually the longest. The ends of the segments are slightly larger than elsewhere and the articulations are all somewhat oblique to the axis of the segments. The terminal segment at its tip appears almost as though cut off, the end being very abrupt. In the male there are two or three longitudinal ridges on each filament segment except the first and last (eleventh) with depressions between. At the outer end of each of the segments these ridges appear to be more or less joined to each other, so that any two would have somewhat the outline of the letter U. Traces of these ridges may also be found on the distal end of the first and basal part of the last filament segments. The surface of the filament, particularly its outer half or two-thirds, is frequently sericeous, caused by the presence of a dense layer of short, decumbent, very minute hairs which may give the surface a dull black, dull brown, or other color quite different from that of the chitin which always seems when unclothed to have somewhat of a luster. (Plate VIII, fig. 12.)

*Prothorax*.—The prothorax is naturally divided into two parts—the slender, more or less elongated portion which articulates with the

head, and which may be termed the neck, and the larger, posterior portion articulating with the mesothorax, which may be termed the collar. The neck joins the head at the center of a circular concavity of the latter, which permits a free movement of the head on the body.

The dorsal surface of the neck is rather flat; at its posterior end it suddenly broadens and unites with the anterior face of the collar, the two faces being nearly or quite at right angles to each other in some cases. On each side of the neck is a pronounced double suture extending backward, the sutures in the posterior half separating somewhat, leaving a narrow plate between them which may be pleural in its nature. Beneath, the neck is shorter, soon broadening and showing a median longitudinal groove. After thus widening it narrows, fitting like a wedge into the base of the collar, which enlarges, forming a pair of lobes to each of which a coxa is articulated.

The anterior face of the collar is quite high, rising nearly or occasionally quite to the height of the mesonotum. Above, it forms a rounded crest behind which the posterior face lies, often nearly parallel with the anterior one, its lower edge articulating with the anterior edge of the mesonotum. Sometimes the collar is closely appressed to the mesothorax; sometimes there is considerable space between them above. At the sides the surface of the collar is nearly vertical, rather triangular in outline and somewhat depressed near its middle, the vertex of the triangle being the edge of the crest already referred to. The width of the collar from front to rear varies in different subgenera, it being most compressed in *Proterosphaea*, while in some of the other subgenera it is quite broad and its anterior surface is rounded vertically, thus making less than a right angle with the dorsal surface of the neck.

The lower back corner of the triangle forming the side of the collar is prolonged downward and backward and ends about opposite the middle of the posterior side of the fore coxa. From near the middle of the hinder margin of the side of the collar a lobe projects backward, coming in contact with the lateral margin of the mesonotum above, and overlying a depression of the mesopleuron in which a stigma is located and which it conceals. This lobe, called the "schulterbeule" by the Germans, I have termed the prothoracic lobe. Its outline varies somewhat in different subgenera. (Plate VI, figs. 1 and 2.)

*Mesothorac.*—The mesonotum is a broad plate lying between the fore wings and in front of them, extending to the hinder part of the collar anteriorly and to the prothoracic lobe at the sides. It is somewhat convex, and its sides and posterior edge are bent slightly upward or reflexed, forming a sort of flange varying in amount. Starting at the middle of the anterior margin and extending back one-third to one-half the length of the plate or even more, a groove is sometimes seen, varying in width, depth, and in the degree in which its edges are

developed, these last being sometimes very sharp and giving to the groove the appearance of a gutter. Occasionally a trace of a short lateral groove parallel with the central one may be seen lying a short distance from the base of the wing, and representing the parapsidal groove. Directly behind the mesonotum lies the scutellum, at the sides of which the hind wings are attached. This plate is much broader than long, convex, and with a more or less developed central elevation which is often partially divided into right and left halves by a weak central groove. As a general thing the central elevation is higher than the highest part of the mesonotum.

The mesothoracic pleuron is large and lies below the wing, its posterior edge being approximately indicated by an oblique groove extending downward and backward from beneath the wing nearly to the anterior side of the mesocoxa, where it ends at a swelling which apparently serves to prevent too great a dorsal flexure of this segment of the leg. Near the base of the fore coxa a groove is also present which passes from beneath upward through the pleuron somewhat behind the prothoracic lobe. This is known as the episternal groove, and it varies in amount of development in different species. Immediately around and behind the prothoracic lobe the mesopleuron is noticeably hollowed out as though for the accommodation of this lobe. There is no suture or other mark of separation between the pleuron and sternum, and no characters have been observed on the latter which are useful for the distinction of species except a short longitudinal incision about half-way from the median sternal suture to the angle where the surface curves upward to form the side of the body.

*Metathorax.*—The postscutellum, which lies immediately behind the scutellum, is a somewhat similar but narrower plate. Its anterior margin is nearly straight, but its posterior margin curves backward slightly, the plate having its greatest antero-posterior length in the middle. The central portion is the highest, though not as high as the scutellum, and like the latter it may have a slight median groove. The metapleuron has a small, rounded, swollen area or metapleural lobe near its middle dorsally, a little below the place of origin of the hind wing. This area is often pubescent when the remainder of the plate is not so, in which case it is very noticeable. The metapleuron narrows ventrally, its narrowest point being a little below the middle. Here it appears to turn and extend horizontally back to the base of the petiole, the sternum of the median segment not being visible. The lines or sutures separating it from the mesopleuron in front and the median segment behind disappear near the base of the mesocoxa, and the dorsal line separating its lower part from the pleuron of the median segment above is very faint or may even be absent. The real limits of the pleura of the meso- and metathorax and of the median segment can, indeed, be hardly regarded as having been finally settled,



and those here given are likely to be modified by more careful study of the development of these insects. It is certain that the limits here indicated are most unsatisfactory to the writer. As in the mesothorax no dividing line between the pleuron and sternum is visible, and the latter plate has no distinctive features of value.

*Abdomen.*—The median segment or propodeum is really the first segment of the abdomen, which has assumed close connection with the thorax and has often been considered as one of the segments of that division. It is followed by a remarkably slender, constricted portion of the second abdominal segment, termed the petiole, at the hinder end of which the plates of the segment suddenly enlarge to average size. The first segment of the abdomen then is closely joined to the thorax and separated from the greater part of the abdomen by the constricted petiolar part of the second segment. This misleading appearance should be kept in mind in any morphological considerations, but as a matter of convenience in this paper the petiole together with its enlarged posterior end is counted as the first abdominal segment.

The median segment lies between the metathorax and the petiole, and is more or less completely fused with the former. Its dorsal surface or dorsum lies immediately posterior to the post-scutellum and extends backward more or less horizontally for some distance to where the outline of the body bends ventrally toward the petiole. At this point there is a depression or fovea of the chitin on the median line, which varies in outline in different species. In some cases it is decidedly crescentic, the concavity of the crescent being dorsal, while in other cases it is nearly circular in outline. The depth of the fovea also varies, being much greater in some cases than in others. On each side of the median segment, nearly on the line of the attachment of the wings and about halfway from the front to the rear of the dorsum is a stigma—the stigma of the median segment. A more or less well-developed line joins the upper end of the stigma with the fovea on the one hand and with the side of the anterior edge of the dorsum at the post-scutellum on the other, these lines taken together limiting the dorsum and giving to it a somewhat shield-shaped outline when viewed from above, the form varying somewhat in different species according as the direction of these lines varies.

In many of the Chlorioninae a groove extends forward from the side of the petiole, passing a short distance above the base of the metacoxa, where it is interrupted by a small swelling serving to check too great an upward movement of the coxa, and curving upward till it unites with the ventral end of the stigma of the median segment. This groove is known as the stigmal groove. The portion of the median segment between the fovea and the petiole, and extending as far to each side as this groove, may for convenience be designated as the posterior end of the segment. (Plate VI, fig. 1.)



About halfway or a little less from the metacoxa to the stigma a faint horizontal ridge or line may be seen, extending forward till it joins the posterior metapleural suture or line, often at the bottom of a small depression. In forms where the stigmatal line is absent this line may sometimes be traced backward to the petiole, its course being a little above where the stigmatal groove would be in that region if it were present. This line between the stigmatal groove and the posterior metapleural line may be regarded as marking the line of separation between the lower part of the metapleuron and the pleuron of the median segment, which would lie dorsal to this line, anterior to the stigmatal groove, posterior to the vertical part of the metapleuron, and below the front part of the dorsum of the median segment.

The petiole is cylindrical, very slender, varying in length, and may either be straight or curved, the arch of the curve when this occurs being downward. At its base above is a small levator muscle or funiculus which is quite noticeable. Measurements of the length of the petiole are often difficult to obtain, as the posterior end of the median segment is frequently densely covered with long hair. The measurements of the petiole used in this paper are for this reason taken from the posterior end of the levator muscle to the point on the dorsal surface where the abdomen begins to enlarge and turn dorsally.

The part of the abdomen behind the petiole is more or less ovate in form, most pointed at the tip in the females, in which sex six segments are perceptible. The dorsal plate of the first segment rises sharply from the petiole, the angle varying, the plate being nearly or quite perpendicular to the petiole in some cases. The stigmata of this plate may lie in front, in the middle, or behind the middle of the plate, a character useful in subgeneric determinations. The other segments, except the sixth (terminal) usually have no structural features of importance in the female. The ventral plate of the terminal segment in this sex is frequently longer than the dorsal one, and just above its tip the sting may be protruded. In other cases the two plates extend an equal distance. The outline of the posterior edge in these plates varies and is a useful systematic character, as are also groups of hairs on the ventral plates of these segments. The sixth ventral segment is frequently quite strongly arched laterally, and in *Palmodes* it is even compressed, so as to give a median longitudinal ridge which forms an edge between the two sides of this plate.

In the male the abdomen is less pointed behind than in the female and is more or less curled downward near its tip. Seven segments are perceptible on its upper side, and eight beneath. The first four dorsal plates are quite large and are wider from front to rear than the others. The outline of the posterior edges of the hinder dorsal plates, particularly of the last, is of importance. Beneath, the first four plates are also larger than the others, the fifth, sixth, and seventh being much

more narrow and liable to be flat or even somewhat hollowed inward. The form of the eighth (terminal) plate is usually more or less triangular and the outline of its posterior edge is of systematic value. Tufts of hairs are frequently present at the sides of the hinder plates beneath, and in *Isodontia* rows of stiff hairs along the posterior margins of these plates are characteristic of the subgenus. In some species the fourth and fifth ventral segments each have a median area densely sericeous in nature and usually of a dark color. The genitalia of the male often protrude somewhat between the last dorsal and ventral plates and in some species are so large as to show their structure quite well even when drawn in as far as possible.

*Wings.* The wings are quite large, and, though sometimes hyaline, are usually more or less colored, either in part or entirely, as already described. It has seemed best in this paper to follow the nomenclature of the veins and cells used by Cresson and others, but drawings have been included which name the parts according to the Comstock system, these having been obtained through the kind assistance of A. D. MacGillivray, of Cornell University. (Plate VII, fig. 8; Plate VIII, fig. 10.)

*Fore wings.*—The radial cell is elongated, rounded at its outer end. Separating it from the costal cell is a well-developed stigma. Three closed cubital cells are present, except in cases of abnormal venation, lying between the costal cell, the stigma and the radial cell in front, and the first and third discoidal and second apical cells behind, the vein between these last and the cubital cells being the cubital vein. Of the three closed cubital cells the first is much the largest. The second and third vary in size according to the position of the transverse cubital veins which separate them. In some subgenera the first and second transverse cubital veins, which run approximately parallel, are so near each other that the second cubital cell is much longer between the radial and the two discoidal cells than it is in the other direction, a condition usually expressed as "higher than broad." In *Proterosphaer* this cell has about the same diameter in each direction, while in *Isodontia* the breadth tends to be noticeably greater than the height. The third cubital cell is roughly triangular in form, the third transverse cubital vein passing at first obliquely outward and forward from the cubital vein, then bending inward and joining the radial vein not far from where the second transverse cubital vein unites with the latter. Two of the three cells immediately behind the cubitals are closed and are termed the "first and third discoidal cells," while toward the tip of the wing from the last named is the unclosed second apical cell, which lies posterior to the outer portion of the third cubital cell. Separating the two (first and third) discoidal cells and the second apical cell are two recurrent veins, the first of which arises posteriorly from the anterior outer angle of the second discoidal cell, which lies posterior to the first discoidal cell, the second recurrent vein arising from the

subdiscoidal vein. The places where these recurrent veins unite with the cubital vein vary as regards the cubital cells, not only in different species but in different individuals of the same species. As a general rule the first recurrent vein joins the cubital opposite some part of the second cubital cell, though it sometimes unites with the cubital directly opposite the junction of this with the second transverse cubital, in which case it is spoken of as being interstitial with the latter vein. Similarly the second recurrent vein usually joins the cubital somewhere on the inner half of the third cubital cell, though in *Sphex* (*Leucosphegus* Authors) and *Sceliphron*, belonging to the other subfamilies of the Sphecidae, it unites with the cubital vein behind the second cubital cell. The distance apart on the cubital vein of the second transverse cubital and second recurrent veins as compared with the distance apart of the second and third transverse cubitals on the radial vein is frequently a useful comparison in diagnosis.

The outer part of the wing is free from closed cells, but the cubital and subdiscoidal veins extend into this portion somewhat, partially separating the fourth cubital, second apical, and first apical cells. The amount of development of these veins beyond the closed cells differs in different species. (Plate VII, fig. 7, and Plate VIII, fig. 9.)

Along the outer portion of the hinder margin of the wing, on the anal cell, is a fold known as the frenal fold, in which the frenal hooks of the hind wing catch, so that the two wings may act together.

*Hind wings.*—The more important features of the venation of the hind wings are as follows: The radial vein varies somewhat in the angle it makes in bending toward the apex just after leaving the costa. The path of the transverse cubital vein also varies, it in some cases being a nearly straight cross vein between the radial and cubital, while in others it curves so as to practically unite the last-named veins in a regular curve. Sometimes the portion of the cubital vein outside the transverse cubital is developed to a greater or less degree, more often only a dark shade is present in that place, and sometimes there is almost no trace of it present. The discoidal vein may have the cubital either external to the junction of the median, cubital, and transverse median veins or at their junction. The angle between the transverse median and the median veins (whether less, equal to, or more than a right angle measured internally) and the amount of curvature of the former are sometimes of some distinctive value, as is also the presence and amount of a slight backward curve near the middle of the cubital vein. The posterior lobe of the wing which extends from the base to the sinus is well developed and an axillary vein besides two folds are present.

*Tegulae.*—The tegula is a small chitinous plate lying over the base of the fore wing and separating it from the side of the mesothorax. It is somewhat arched, frequently with slightly reflexed edges, and is often somewhat sericeous or pubescent, particularly near the middle.

*Legs.*—The legs are long but not very stout, the coxæ, trochanters, and femora unarmed with spines, but generally more or less hairy and frequently sericeous, sometimes even pubescent. The tibiae are provided with spines on the sides and at the ends; the metatarsus is similarly armed and the other tarsal segments are spiny beneath and at their tips, but not above.

The fore coxæ are large and their basal articulations with the body are close together. Each is conical or subconical in form, the trochanter articulating at the apex. The trochanter is well developed, larger distally, and at its outer end joins the femur, which is smaller at this articulation than elsewhere. The fore femur is the shortest of the femora, but is quite stout and frequently bears a row of well-developed hairs along its under surface. The fore tibia is the only tibial segment of either of the legs, which is much shorter than the femur. It enlarges gradually toward its tip and bears rather short, stout spines on its sides, which sometimes show a partial arrangement in longitudinal rows. At the tip of the tibia are several spines, two of which are larger than the others, besides a long, curved, much modified spine bearing fine hairs on its inner surface, which, in connection with a corresponding modification at the base of the first tarsal segment (metatarsus), acts as a cleaning apparatus. (Plate IX, fig. 21.)

There are five tarsal segments: The first is much longer than the next three, and considerably longer than the fifth, and is called the metatarsus. This segment, in addition to short, irregularly distributed spines, has a row of them on the inner side and a similar one on the outer side. In the females a second row of much longer ones, called a "tarsal comb," is also present on the outer side of the metatarsus, the spines of the two rows alternating more or less regularly with each other except at the distal end of the segment, where two or three of the longer set are usually the only ones present. This row of long spines appears to be utilized in digging the holes in which the eggs of the insects and the food are placed, hence is absent in the males and in the subgenus *Isodontia*, which makes use of cavities in stems of plants and similar places as its breeding places. (Plate X, fig. 27.)

At the tip of the last tarsal segment is a pair of well-developed, curved claws, between which is a large pulvillus. On the inner (under) side of the claw, between its base and the middle, are from one to five or even six teeth. These may be pointed or blunt, well-developed or more or less rudimentary, and their number is useful in connection with other characters in determining the subgenera.

The middle coxæ are somewhat more widely separated at their articulations with the body than the fore coxæ. The femora and tibiae are of nearly equal length, the latter being a very little the shorter. Aside from these differences and the absence of a cleaning apparatus at the tip of the tibia the mesothoracic legs differ little from those of the prothorax.



The articulations of the hind coxæ with the body are close together and at the very posterior end of the under surface of the thorax, the coxæ projecting distinctly backward. The tibia is slightly longer than the femur and its hinder surface is coarsely sericeous, almost pubescent. In some cases the inner side of the hind tibia is suddenly swollen near the end, though the segment usually only gradually increases its diameter in going out from the body. At the end of the tibia are two long spines, one of which has been modified to form a cleaning apparatus. The outer edge of this spine is nearly straight, but its inner edge for the third of its length nearest the tibia rapidly increases and apparently is formed by very closely set hairs. The rest of the inner edge bears a row of stiff hairs or teeth, longest near the middle. The differences in the structure of this inner edge are useful in subgeneric determinations. The hind metatarsus is usually straight. In one case (*Proterosphecia tepanicum* Saussure), however, it is noticeably curved near its base. The tarsus as a whole is like those of the other legs. (Plate VI, figs. 3, 4.)

*Sexual distinctions.*—Aside from the presence of a sting in the females and of more or less evident copulatory organs in the males, many differences may frequently be noticed in the two sexes. In the females the antennæ are composed of 12 segments while in the males 13 are present, and show several longitudinal ridges, as already described. The inner margins of the eyes generally converge downward in the males. The outline of the anterior edge of the clypeus is more strongly developed, a tarsal comb is absent, the outline of the hinder end of the abdomen is less pointed than in the females and more abdominal plates are present and are of a different form, the clothing of the body is generally more developed and in the species here treated the male is smaller than the female.

#### CLIMATIC VARIATION.

Variation in members of the Chlorioninae in relation to climate is not very marked. Certainly the more highly colored forms are from the tropical and subtropical regions, while black is more prevalent in northern examples, but no striking differences in this regard are noticeable. In a general way, however, it may be said that in species showing varying amounts of black and ferruginous the black covers more of the surface and that the ferruginous is less rich and strong in northern than in southern specimens. Pubescence in amount and in richness of color has also the same characters. In northern examples there is less of it and it is usually rather pale, while in insects from the Southern States, Mexico, and the West Indies it becomes more abundant, often forming a dense covering for almost the entire body except the abdomen, and its color is much deeper and richer. In one or two cases colors other than those usual to the group appear, as in

*Proterosphaer tepanicum* Saussure, in which the greater part of the first three dorsal abdominal plates has a distinct reddish, almost purplish, shade, and as in the case of *P. latreillii* Lepeletier of Chili (extra-limal to this paper), where the thoracic pubescence is almost crimson. All such cases of departure from what may be termed typical colors seem to occur in tropical or subtropical regions, never in the cooler ones.

#### ANALYTICAL KEYS.-

An excellent table of the families of the Sphegoidea is given by Doctor Ashmead,<sup>a</sup> and those who wish to place Sphegoidea in their families should consult that table. There follows below a table of the subfamilies of the Sphecidae, which is practically only a somewhat rearranged copy of the one by Doctor Ashmead:<sup>b</sup>

#### ANALYTICAL KEY TO SUBFAMILIES.

1. Second cubital cell receiving only the first recurrent vein; the second recurrent vein received by the third cubital cell, or at least beyond the second transverse cubital. (Both recurrent veins are received by the first cubital cell in a few extra-limal forms) ..... 2.  
 Second cubital cell receiving both recurrent veins, or the second recurrent vein is interstitial with the second transverse cubitus, although sometimes the first recurrent is interstitial with the first transverse cubitus, or then received by the first cubital cell ..... 3.
2. Antennæ inserted on the middle of the face; claws with one to six teeth beneath; tibiæ *strongly spinous*, or at least never with weak or feeble spines; tarsal comb in female present (except in *Isodontia*) ... CHLORIONINÆ (SPHECINÆ Authors).  
 Antennæ inserted far anterior to the middle of the face; claws simple, without teeth, or at most with a single small tooth near the middle; tibiæ *smooth*, not spinous; tarsal comb in female never present ..... PODINÆ.
3. Claws simple, *without* a tooth beneath; tibiæ more or less spinous; tarsal comb in female present; abdomen most frequently very elongate, the petiole composed of 2 segments; rarely of only 1 segment; cubital vein of hind wings usually originating beyond the transverse median vein.

SPHECINÆ (AMMOPHILINÆ Authors).

Claws with a single tooth beneath, although sometimes very minute; more rarely without a tooth, the claws simple; tarsal comb in female absent; abdomen always with a one-segmented petiole; cubital vein of hind wings interstitial or nearly so. .... 4.

4. Antennæ inserted on the middle of the face; metathorax with a large U-shaped area above; mesopleura not longer than the height of the thorax.

SCELIPHRONINÆ.

Antennæ inserted far anterior to the middle of the face, *on* or just above an imaginary line drawn from base of eyes; metathorax *without* a large U-shaped area above; mesopleura much longer than the height of the thorax. ... PODINÆ.

As, according to the views of the writer, there is but one genus—*Chlorion*—in the subfamily Chlorioninæ the table above leads not only to the Chlorioninæ but also to the genus *Chlorion*.

<sup>a</sup> Canadian Entomologist, XXXI, p. 152.

<sup>b</sup> Idem, p. 348.

## KEY TO THE SUBGENERA AND SPECIES OF THE GENUS CHLORION.

1. Second cubital cell of fore wing higher than broad..... 2.  
     Second cubital cell of fore wing as broad or broader than high, rectangular, or  
     rhomboidal ..... 17.
2. Claws with one tooth..... (Subgenus *Chlorion*) 3.  
     Claws with two or more teeth..... 4.
3. Body bright blue or green ..... *Chlorion cyaneum* Dahlbom (p. 313).  
     Body bronze blue..... *Chlorion cyaneum ararium* Patton (p. 317).
4. Claws with two teeth; clypeus with a median truncated lobe and a sinus on each  
     side ..... (Subgenus *Palmodes*) 5.  
     Claws with three to six teeth; clypeus without a median truncated lobe but often  
     with a median emargination or notch..... (Subgenus *Priononyx*) 8.
5. Abdomen black or at most only faintly brownish or ferruginous.  
     *Palmodes leviventris* (Cresson) (p. 318).  
     Abdomen more or less ferruginous or yellow..... 6.
6. Abdomen entirely ferruginous or yellow..... 7.  
     Tip of abdomen black ..... *Palmodes abdominalis* (Cresson) (p. 322).
7. Wings yellow; female with seven comb teeth. *Palmodes praestans* (Kohl) (p. 328).  
     Wings filiginous; female with six comb teeth.  
     *Palmodes rufiventris* (Cresson) (p. 325).
8. Females..... 9.  
     Males..... 13.
9. Clypeus slightly rounded anteriorly, with no median emargination or notch.  
     *Priononyx ferrugineum* (Fox) (p. 331).  
     Clypeus with a median emargination or notch ..... 10.
10. Abdomen black or dark brown ..... *Priononyx atratum* (Lepeletier) (p. 338).  
     Abdomen more or less ferruginous or yellow..... 11.
11. Mesonotum rugose..... *Priononyx striatum* (Smith) (p. 335).  
     Mesonotum not rugose ..... 12.
12. Prothoracic lobe pubescent (not always sufficient to separate from the  
     next) ..... *Priononyx thomæ* (Fabricius) (p. 342).  
     Prothoracic lobe not pubescent (not always sufficient to separate from the  
     last) ..... *Priononyx bifoveolatum* (Taschenberg) (p. 346).
13. Clypeus slightly rounded anteriorly, with no median emargination or  
     notch ..... *Priononyx ferrugineum* (Fox) (p. 331).  
     Clypeus with a median emargination or notch ..... 14.
14. Ventral plate of sixth abdominal segment broadly excavated on its posterior  
     margin..... *Priononyx bifoveolatum* (Taschenberg) (p. 346).  
     Ventral plate of sixth abdominal segment not thus excavated ..... 15.
15. Mesonotum noticeably rugose..... *Priononyx striatum* (Smith) (p. 335).  
     Mesonotum not noticeably rugose..... 16.
16. Abdomen at least partly ferruginous..... *Priononyx thomæ* (Fabricius) (p. 342).  
     Abdomen black or dark brown..... *Priononyx atratum* (Lepeletier) (p. 338).
17. Stigmatal groove rudimentary or absent..... 18.  
     Stigmatal groove present ..... (Subgenus *Proterosphex*) 29.
18. Third cell not broader on the radial vein than the distance between the  
     second transverse cubital and second recurrent veins on the cubital vein.  
     *Proterosphex lucæ* (Saussure) (p. 365).  
     Third cubital cell broader on the radial vein ..... (Subgenus *Isodontia*) 19.
19. Mandible with two teeth (anterior tooth sometimes partly divided) ..... 20.  
     Mandible with three teeth..... 27.
20. Petiole black ..... 21.  
     Petiole more or less ferruginous or yellow ..... 26.

21. Without golden thoracic pubescence ..... 22.  
 With golden thoracic pubescence ..... *Isodontia costipennis* (Spinola) (p. 351).
22. First segment of antennal filament longer than fifth or sixth ..... 23.  
 First segment of antennal filament shorter than fifth or sixth ..... 24.
23. Median segment without long white hairs above.  
       *Isodontia aztecum*, female, (Saussure) (p. 353).  
 Median segment with many long white hairs above.  
       *Isodontia aztecum cinereum*, female, (H. Fernald) (p. 356).
24. Body hairs gray ..... 25.  
 Body hairs black ..... *Isodontia aztecum* var., male, (Saussure) (p. 356).
25. Front part of wings fuliginous ..... *Isodontia aztecum*, male, (Saussure) (p. 354).  
 Wings entirely fuliginous ..... *Isodontia aztecum* var., male, (Saussure) (p. 356).
26. Wings dark fuliginous ..... *Isodontia exornatum* (H. Fernald) (p. 350).  
 Wings yellowish: at most only somewhat fuliginous.  
       *Isodontia costipennis* (Spinola) (p. 351).
27. Legs black ..... *Isodontia harrisi* H. Fernald (p. 359).  
 Legs more or less yellowish ..... 28.
28. Abdomen black ..... *Isodontia auripes* H. Fernald (p. 356).  
 Abdomen more or less yellowish ..... *Isodontia elegans* (Smith) (p. 361).
29. Females ..... 30.  
 Males ..... 49.
30. Hind tibiae suddenly thickened at the end on the inner side.  
       *Proterosphex cubensis* H. Fernald (p. 367).  
 Hind tibiae not suddenly thickened ..... 31.
31. Abdomen more or less red or reddish yellow ..... 32.  
 Abdomen black (one exception) ..... 40.
32. Legs black ..... 33.  
 Legs more or less red or rusty yellow ..... 34.
33. Abdomen partly black; pubescence pale straw to silvery white.  
       *Proterosphex texanum* (Cresson) (p. 414).  
 Abdomen entirely reddish; pubescence golden yellow.  
       *Proterosphex lautum* (Cresson) (p. 371).
34. Anal segment red; some of the abdominal segments black.  
       *Proterosphex dubitatum* (Cresson) (p. 394).  
 Anal segment red or black; when red the other abdominal segments are also  
   red ..... 35.
35. None of the abdominal segments black ..... 36.  
 Hinder abdominal segments black; petiole black ..... 39.
36. Petiole black ..... *Proterosphex resinipes* H. Fernald (p. 386).  
 Petiole red, orange, or yellow ..... 37.
37. Hairs on dorsum of median segment gray.  
       *Proterosphex ashmeadi*, new species (p. 389).  
 Hairs on dorsum of median segment not gray ..... 38.
38. Wings hyaline, with a yellow tinge.  
       *Proterosphex ichneumoneum aurifurum* (Perty) (p. 403).  
 Wings more or less fuliginous.  
       *Proterosphex ichneumoneum fulviventris* (Guerin) (p. 403).
39. Femora red (rarely black near base); a pubescent band along the stigmatal  
   groove ..... *Proterosphex ichneumoneum* (Linnaeus) (p. 399).  
 Femora black (sometimes red at tip); no pubescent band along the stigmatal  
   groove ..... *Proterosphex maximiliani* (Kohl) (p. 397).
40. Legs partly rust red or rust yellow ..... 41.  
 Legs black ..... 46.



41. With a small pubescent spot above the middle and hind coxæ.  
*Proterosphex brasiliunum* (Saussure) (p. 412).  
 Without these pubescent spots ..... 42.
42. With pubescence on thorax and median segment ..... 43.  
 Without such pubescence.....*Proterosphex bridwelli* (H. Fernald) (p. 384).
43. Tibiæ and tarsi rusty yellow ..... 44.  
 Tip of hind tibiæ and the hind tarsi black.  
*Proterosphex flavitarsis iheringii* (Kohl) (p. 381).
44. Wings fuliginous with violet reflection.  
*Proterosphex flavitarsis* H. Fernald (p. 379).  
 Wings not fuliginous..... 45.
45. Wings with a distinct yellow tinge.  
*Proterosphex flavitarsis saussurei* H. Fernald (p. 381).  
 Wings pale, without a yellow tinge.  
*Proterosphex flavitarsis guatemalensis* (Cameron) (p. 381).
46. Longer body hairs black ..... 47.  
 Longer body hairs not black..... 48.
47. Wings rusty yellow or yellowish brown.  
*Proterosphex caliginosum* (Erichson) (p. 403).  
 Wings deep fuliginous, with violet reflection.  
*Proterosphex pennsylvanicum* (Linnæus) (p. 405).
48. Pubescence golden yellow .....*Proterosphex habenum* (Say) (p. 374).  
 Pubescence pale yellow or nickel in color.  
*Proterosphex brasiliunum* (Saussure) (p. 412).  
 Pubescence dull white .....*Proterosphex mandibularis* (Cresson) (p. 410).
49. Hind tibiæ suddenly thickened at the end on the inner side.  
*Proterosphex cubensis* H. Fernald (p. 367).  
 Hind tibiæ not suddenly thickened ..... 50.
50. Hind metatarsus distinctly curved its entire length.  
*Proterosphex tepanecum* (Saussure) (p. 377).  
 Hind metatarsus not noticeably curved..... 51.
51. Hind edge of last dorsal abdominal segment above, truncated..... 52.  
 Hind edge not truncated (with a central emargination or notch in some cases). 55.
52. Tibiæ and tarsi rusty yellow ..... 53.  
 Tip of hind tibia and entire hind tarsus black.  
*Proterosphex flavitarsis iheringii* (Kohl) (p. 381).
53. Wings fuliginous with violet reflection.*Proterosphex flavitarsis* H. Fernald (p. 379).  
 Wings not fuliginous..... 54.
54. Wings with a distinct golden tinge.  
*Proterosphex flavitarsis saussurei* H. Fernald (p. 381).  
 Wings pale, without a yellow tinge.  
*Proterosphex flavitarsis guatemalensis* (Cameron) (p. 381).
55. Seventh ventral abdominal plate with a central spine (sometimes hidden under the sixth plate).....*Proterosphex spiniger* (Kohl) (p. 392).  
 Seventh ventral abdominal plate without a spine..... 56.
56. Legs partly or wholly rust red or rust yellow ..... 57.  
 Legs black ..... 64.
57. Abdomen more or less red or yellow ..... 60.  
 Abdomen black..... 58.
58. Wings nearly hyaline; hind tibiæ (and tarsi except terminal segment) yellow or red ..... 59.  
 Wings strongly fuliginous; hind legs entirely black.  
*Proterosphex beatum* (Cameron) (p. 411).

59. Wings with weak yellow reflection; pubescence abundant, golden or coppery.  
*Proterospheæ brasilianum* (Saussure) (p. 412).  
 Wings without yellow reflection; pubescence pale yellowish, very sparse.  
*Proterospheæ nudum* (H. Fernald) (p. 382 ).
60. Pubescent band present on metapleuron along stigmatal groove..... 61.  
 Without such a band..... 63.
61. Abdomen entirely red..... 62.  
 Hinder segments of abdomen black. *Proterospheæ ichneumoneum* (Linnaeus) (p. 399).
62. Wings more or less fuliginous.  
*Proterospheæ ichneumoneum fulviventris* (Guerin) (p. 403).  
 Wings quite hyaline, with a weak yellow tinge.  
*Proterospheæ ichneumoneum aurifluum* (Perty) (p. 403).
63. With golden or coppery pubescence... *Proterospheæ maximiliani* (Kohl) (p. 397).  
 Pubescence silvery; usually almost entirely absent.  
*Proterospheæ ashmeadi*, new species (p. 389).
64. Abdomen black..... 66.  
 Abdomen in part or wholly red..... 65.
65. Pubescence golden, abundant..... *Proterospheæ lautum* (Cresson) (p. 371).  
 Pubescence silvery white..... *Proterospheæ texanum* (Cresson) (p. 414).
66. Longer hairs of thorax gray..... 67.  
 Longer hairs of thorax wholly black..... 68.
67. Wings quite fuliginous, with bluish or violet reflection; cubital vein of hind wing  
 well developed beyond transverse cubital.  
*Proterospheæ chichimecum* (Saussure) (p. 407).  
 Wings nearly hyaline; cubital vein almost wanting beyond the transverse cubital.  
*Proterospheæ texanum* (Cresson) (p. 414).
68. Wings yellow..... *Proterospheæ caliginosum* (Erichson) (p. 403).  
 Wings deep fuliginous with violet reflection.  
*Proterospheæ pensylvanicum* (Linnaeus) (p. 405).

#### DESCRIPTIONS.

The lists of literature of these insects given by Kohl, and particularly by Dalla Torre,<sup>a</sup> are so full that it has not seemed necessary to give complete lists here. Accordingly only the more important older foreign references are given, though it has been my intention to make the American references and those published since Dalla Torre's list as complete as possible.

The characters given for the subgenera are correct for American forms, but would need modification if applied to certain Old World species.

#### Genus CHLORION Latreille

*Chlorion* LATREILLE, Hist. Nat. Crust. et Ins., III, 1802, p. 333.

*Type*.—*Sphæx lobatus* Fabricius, Syst. Ent., 1775, p. 348.

This being the only genus of the Chlorioninæ, the description of the external anatomy already given will apply here and need not be repeated.

<sup>a</sup> Catalogus Hymenopterorum, VIII.

Subgenus **CHLORION** Latreille (genus): Kohl.

*Chlorion* LATREILLE, Hist. Nat. Crust. et Ins., III, 1802, p. 333.

*Dryinus* FABRICIUS, Syst. Piez., 1804, p. 200.

*Promecus* LATREILLE, Gen. Crust. et Ins., IV, 1809, p. 56.

*Chlorion* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 112.

*Type.* *Chlorion (Chlorion) lobatum* Fabricius, Syst. Ent., 1775, p. 348.

Second cubital cell of the fore wing much higher than broad. Claws with a single tooth near the middle of the inner edge. Anterior border of the clypeus with teeth. Median segment with a stigmal groove. Stigma of the first dorsal abdominal plate placed in front of the middle. Tarsal comb of the female well developed. Body metallic, glistening. (Plate IX, fig. 13; Plate X, fig. 22.)

The genus *Chlorion* as established by Latreille does not in all respects agree in diagnosis with the type,<sup>a</sup> but as it was a monotypical genus, and only later had *compressa* added to it, and as the first reviser, Jurine, retained *lobatus* as the type and removed *compressa* to his new genus *Ampulex*, this assignment is not subject to subsequent change."<sup>b</sup> Patton<sup>c</sup> also takes this view.

**CHLORION (CHLORION) CYANEUM** Dahlbom.

? || *Sphex cerulea* LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 941.

? || *Sphex cerulea* DE GEER, Mem. Hist. Nat. Ins., III, 1773, p. 589, pl. xxx, fig. 6.

|| *Sphex cerulea* DRURY, Ill. Nat. Hist. Ex. Ins., II, 1773, p. 75, pl. xxxix, fig. 8.

? *Sphex cyanea* FABRICIUS, Syst. Ent., 1775, p. 346.

? *Sphex cyanea* FABRICIUS, Ent. Syst., II, 1793, p. 201.

? *Pepsis cyanea* FABRICIUS, Syst. Piez., 1804, p. 211.

*Chlorion cyaneum* DAHLBOM, Hym. Eur., I, 1843, p. 24.

*Chlorion cyaneum* DAHLBOM, Hym. Eur., I, 1845, p. 435.

? *Sphex cerulea* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 336.

*Chlorion ceruleum* WALSH, Am. Ent., I, 1869, p. 164.

*Chlorion ceruleum* RILEY, First Rept. U. S. Ent. Com., 1878, p. 319 (in part).

*Chlorion cyaneum* PACKARD, Guide to Study of Ins., 8th ed., 1883, p. 167.

*Sphex cerulea* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 29.

*Sphex (Chlorion) nearcticus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 186.

*Sphex (Chlorion) occultus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 187.

*Chlorion ceruleum* ASHMEAD, Ins. Life, VII, 1894, p. 241.

*Chlorion ceruleum* ASHMEAD, Psyche, VII, 1894, p. 65.

*Chlorion ceruleum* PECKHAMS, Wisc. Geo. and Nat. Hist. Surv., Bull. 2, 1898, p. 173, pl. II, fig. 3; pl. XI, fig. 4.

*Chlorion cyaneum* H. FERNALD, Ent. News, XV, 1904, p. 117.

Metallic blue, green, or greenish blue on the head and body; body rather slender for its length, generally somewhat blackish sericeous with minute punctures close together.

<sup>a</sup> See Westwood, Trans. Ent. Soc. Lond., III, 1841-1843, p. 227.

<sup>b</sup> International Code of Nomenclature, Art. 30.

<sup>c</sup> Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 379.

*Female*.—Head broader than distance between outer edges of tegulae, narrow from front to rear; clypeus less than half as long as wide, its middle elevated, forming a ridge narrowest behind, broadening anteriorly; posterior outline of clypeus somewhat emarginate near the middle of each side, extending below the eye to the base of the mandible; anterior edge blackish, with five blunt teeth, the lateral one farther from the three near the center than these are from each other (the number of these teeth is subject to individual variation, and I have seen one specimen with none); surface of clypeus rather sparsely, coarsely punctured, bearing black hairs, some near the anterior edge being quite long; least hairy near the posterior emarginations; frons with a more or less evident median elevation from the antennae part way to the median ocellus, this region being quite closely, coarsely punctured and sometimes slightly rugose; surface of frons hollowed on each side of the elevation, most deeply so at the clypeus; above and between the antennae the surface is slightly rugose; surface of frons more or less punctured, the punctures varying in size and abundance in different specimens; bearing numerous short, black hairs, best seen in profile; median ocellus largest; on the inner side of each lateral ocellus is a long, black hair (macrochaeta) and nearer the occiput is a second pair farther apart; behind the ocelli is a faintly marked transverse oval elevated area at the ends of which the posterior pair of macrochaetae lie; surface of vertex and occiput with punctures varying in size and abundance; cheeks quite broad above, narrowing rapidly below; above with scattered punctures which become larger and closer below where there are numerous long, black hairs; a row of black hairs is present on the edge of the occiput; inner margins of the compound eyes converging above, parallel on their lower half; their lower edges nearly at right angles to their inner ones; antennae; scape black, glistening somewhat, sometimes metallic like the body; remainder brownish sericeous; the scape has rather coarse punctures and numerous short, stout hairs except externally; first segment of filament longest, sometimes slightly swollen near its tip, which is surrounded by a number of minute, black hairs, also present on the second, and sometimes on the third and fourth segments; mandibles with two teeth, the terminal one forming half the length of the mandible; anterior tooth blunt; a ridge extends from the base outward and soon forks, a branch passing along each tooth; in the space behind each of these ridges the surface is somewhat aciculated; the anterior tooth and the ventral side of the mandible bear scattered black hairs; color of the mandibles black except for a dull ferruginous area near the junction of the teeth in some cases, and a slight ferruginous tinge near the edges.

*Thorax*.—Collar rather narrow, its sides and posterior face quite vertical, not closely appressed to the mesonotum; anterior face quite vertical below, rounded or sloping backward above; dorsal edge and



upper part of anterior face somewhat depressed in the middle, making the dorsal edge two-humped, the height of these humps varying considerably: neck transversely rugose, these marks varying in strength and frequently extending back onto the lower part of the collar, the surface of which is more or less punctured and bears short black hairs varying in size and abundance like the punctures; side of collar in front of prothoracic lobe sometimes faintly rugose vertically; prothoracic lobe generally quite closely, sometimes sparsely, punctured and with numerous, quite long, black hairs; its posterior edge with a dense fringe of short, pale hairs; prosternum and propleuron with a thickening at their edges, thus placing their suture between two ridges; this is also the case on the middle line of the prothorax beneath, thus dividing the prosternum (?) into right and left halves; sternal surface with numerous punctures and long, black hairs; sericeous; mesonotum sericeous, with punctures varying in abundance and size, and with short, black hairs; from the upper edge of the prothoracic lobe to the tegulae, then back along the side of the plate, and partly across the hinder end, the edge of the mesonotum is upwardly reflexed; two short, faint, impressed lines are present on the middle anteriorly and a faint parapsidal groove is perceptible; scutellum without a median furrow, its central portion elevated to form a nearly flat, transverse, oval area bearing a few scattered, rather small punctures, sometimes very faint or absent; at the anterior lateral sides the plate is not depressed and is somewhat triangular there, the upper surface of this portion being smooth, while its outer side which faces outward is usually slightly rugose, as is also the posterior lateral face of the scutellum in most cases; postscutellum with a slight median impression, a slightly reflexed edge anteriorly, and in general minutely punctured and with a tendency to transverse aciculation; dorsum of median segment not pointed but evenly rounded behind to the fovea, which is a narrow, transverse depression; surface of dorsum transversely rugose, the ridges turning somewhat backward laterally, the rugosity coarsest in front, frequently nearly or quite obsolete behind; there is a distinct median depression on the dorsum, sometimes slight or absent anteriorly; the surface is usually bare, but sometimes bears very short, black hairs; stigmal groove well developed; posterior end of median segment turning downward sharply from the dorsum, its surface coarsely rugose and punctured; in some cases the first ridge below the fovea is much higher than the others and sometimes near the dorsum at the sides the rugosity becomes almost obsolete; the surface is quite well provided with black hairs of medium length, which, near the stigmal groove, are longer and more abundant and the ridges are coarser; mesopleura quite coarsely punctured, sometimes partly rugose, with scattered black hairs; mesosternum marked like the mesopleura and with a median suture; metapleura coarsely, obliquely rugose and with

numerous black hairs, longest and nearest together near the stigmatal groove; petiole straight, glistening, slightly longer than the first filament segment, finely punctured, and with numerous long, black hairs.

*Abdomen*.—Long, ovate, more pointed behind, rather rounded in front, glistening; above somewhat sericeous; stigmata of first segment oblique, in front of the middle; the segments show a few faint, scattered punctures, becoming closer and larger on the last three segments; on the first two of these there is a row of punctures parallel to and a little in front of the hinder margin, with a very few short, black hairs at the extreme side on the first of the two, but extending nearer the middle in the second; the terminal segment has more and longer hairs generally distributed over the surface; its hinder margin is bluntly acuminate and its sides somewhat emarginate near the tip; the margin is sometimes pale, and the entire segment is sometimes black and not metallic; beneath, glistening, sometimes sericeous, with scattered, minute punctures mainly toward the sides and on the front part of the plates in the center; the punctures increase in number and size on the hinder segments; short black hairs have the same distribution as above; last segment coarsely, quite closely, punctured, with a slight median ridge on its posterior portion (sometimes its whole length) and with a slightly thickened posterior margin acutely oval in outline; the front portion of the last segment (usually concealed) is slightly or not at all punctured and the segment may be black and not metallic.

*Wings*.—Dark fuliginous with violet reflection which is lost on the outer margins, these being rather velvety in appearance; fore wing; second cubital cell high and narrow, receiving the first recurrent vein before, at, or beyond the middle; third cubital cell nearly as long as the radial; external end of radial cell rounded; second transverse cubital vein not straight, bending into the second cubital cell; hind wing; discoidal vein interstitial with the median and transverse median veins, the latter two meeting at about right angles; cubital distinct beyond the transverse cubital (which is quite straight); radial vein external to the transverse cubital strongly arched. Tegulae black, slightly sericeous in front, glistening; with scattered, minute punctures and a few short, black hairs; its posterior margin sometimes faintly dull ferruginous.

*Legs*.—Black, somewhat glistening; coxae and trochanters black, metallic in some cases; femora stout, black, sometimes metallic, glistening, with scattered punctures and numerous quite long, black hairs, and somewhat sericeous in some lights; fore and middle tibiae shorter than their femora, brownish; fore tibiae light brownish sericeous on the inner face; fore tarsi brownish, light brownish sericeous beneath, with seven or eight (usually seven) comb teeth; claws almost ferru-

ginous; middle and hind tibiae grayish sericeous; inner contour of hind tibiae straight; spines of all the legs black.

*Male*.—Body and head rather more densely covered with hair and more closely punctured than in the female; clypeus usually with three blunt teeth in front; macrochaetae of ocellar and vertex regions absent or not usually to be distinguished from the other hairs; anterior face of collar as a rule more vertical than in the female; last dorsal abdominal plate evenly rounded, densely punctured, quite hairy, and with a pale hinder margin; second ventral abdominal plate quite smooth, with a few scattered punctures and black hairs; third, fourth, and fifth plates more abundantly punctured but chiefly at the sides and anterior to the middle; sixth plate quite evenly, but not coarsely punctured, slightly emarginate behind; seventh plate narrow, less emarginate than the preceding; eighth (terminal) plate rounded, with numerous punctures and brown hairs; with little or no metallic luster.

*Length*.—Females, 21–31 mm.; males, 19–24 mm.

CHLORION (CHLORION) CYANEUM ÆRARIUM Patton.

*Chlorion ærarium* PATTON, Can. Ent., XI, 1879, p. 133.

*Chlorion cæruleum* var. *ærarium* PATTON, Proc. Ent. Soc. Wash., III, 1896, p. 46.

*Type*.—One female, in the collection of the American Entomological Society at Philadelphia.

This subspecies is readily distinguished by its color, which is bronze blue or purplish blue, and by its somewhat more slender body and generally smaller size.

This beautiful species is widely distributed in North America, but I have no record of it from the West Indies. The typical form is distinctly southern, belonging to the Lower Austral Zone, though it is sometimes found in the southern portion of the Upper Austral, mingling there with *ærarium* which extends through this zone well up toward the Transition Zone, though it occasionally occurs much farther south, and specimens have been taken even in Florida and Texas in which the blue showed a bronze tint. In Texas, New Mexico, Colorado, and California a greenish shade often appears and may in some cases entirely replace the blue.

Kohl<sup>a</sup> finds two species among the specimens of this insect accessible to him and names them *neurcticus* and *occultus*. I am unable to separate these as some specimens show some characters of the one and other characters of the other. Apparently *neurcticus* applies to those forms in which the punctures and rugosity are least developed, while *occultus* is applied to those in which they are strongest; but with an excellent series of intermediates before me I can not regard the differences as marking more than extremes of individual variation.

<sup>a</sup> Ann. natur. Hofmus. Wien, V, 1890, pp. 186–187.

This species provisions its nests with crickets (and perhaps with grasshoppers also). References to its capturing spiders for this purpose are due to a confusion with the smaller *Sceliphron*.

Subgenus **PALMODES** Kohl.

*Palmodes* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 112.

*Palmodes* KOHL, Ann. natur. Hofmus. Wien, XI, 1896, p. 318.

*Type*.—*Chlorion* (*Palmodes*) *occitanicum* Lepeletier and Serville, Ency. Meth., X, 1825, p. 462.

Second cubital cell of the fore wing much higher than broad. Claws with two blunt teeth near the base of the inner edge. Median segment without a stigmatal groove. Clypeus flat, with a median truncated elongation and a sinus at each side. Stigma of the first dorsal abdominal plate at or behind the middle. Tarsal comb of the female developed. Comb teeth of the outer part of the hind tibial spine thorn-like or tooth-like. Inner borders of the eyes parallel in the female, converging downward in the male. Last ventral abdominal plate of the female laterally compressed, almost forming a longitudinal edge in the middle. Ventral abdominal plates of the male flat, the fourth and fifth silky sericeous. Abdomen black, ferruginous, or yellow. (Plate IX, fig. 14; Plate X, fig. 23.)

**CHLORION (PALMODES) LÆVIVENTRIS** (Cresson.)

*Sphex læviventris* CRESSON, Proc. Ent. Soc. Phila., IV, 1865, p. 463.

? *Harpactopus rufiventris* PATTON, Bull. U. S. Geol. and Geogr. Surv., V, 1880, p. 354.

*Sphex* (*Palmodes*) *morio* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 321.

*Types*.—Six female, ten male specimens, in the collection of the American Entomological Society in Philadelphia. Though sixteen specimens were studied when the description was prepared only one bears a label in Cresson's handwriting, and I am told that it was his custom to label but one and regard that as the type. At the present time four females and four males of this lot bear printed "type" labels.

Black, quite robust, without pubescence except on the front of the head; wings uniformly fuliginous; hairs black.

*Female*.—Head broad, quadrangular from above with rounded corners, very slightly excavated in front between the eyes; clypeus broad, somewhat arched near the middle, the sides flat; densely brownish black sericeous, and with numerous punctures and long, black hairs; its anterior margin bare, smooth, slightly reflexed, with a broad median truncated projection, at the side of which is a sinus beyond which the edge turns upward toward the eye, near which it again extends laterally to the base of the mandible below the eye; frons densely brownish-black sericeous; in some cases, together with the clypeus, more or less silvery pubescent; with scattered punctures a



little finer than those on the clypeus, and with hairs somewhat shorter and finer; median suture plainly marked, forking in front of the median ocellus, the two branches continuing obliquely backward till behind the line of the lateral ocelli where they are united by a faint, backwardly arched, transverse suture or groove; traces of the median suture are also present between the lateral ocelli; below, and lateral to the median ocellus is a short, narrow, vertical depression, and behind, and lateral to each lateral ocellus is another smaller one, the four together marking the corners of a quadrangular area within which the ocelli are located; vertex marked like the frons; cheeks minutely punctured, and also with quite numerous larger punctures and long hairs, particularly below; antennae black; scape minutely punctured and with scattered larger punctures and short, stiff hairs; pedicel the same; filament grayish sericeous in certain lights, its first segment longest; the first four segments of the filament show the following length relationships  $\frac{2}{7}$ ,  $\frac{2}{3}$ ,  $\frac{3}{5}$ ,  $\frac{4}{7}$  (average of several examples); mandible black, three toothed, robust, with a slight ferruginous band at the base of the teeth; somewhat punctured or aciculate, with a few long hairs on the under or posterior edge, and on the upper (inner) surface near the base.

*Thorax*.—Neck short; collar rather long, its hinder face vertical, not very high, not closely appressed against the mesonotum; anterior face evenly sloping, with a broad, rounded top, so that the dorsal edge is quite broad and evenly rounded from side to side, highest in the middle; surface blackish sericeous, with numerous coarse punctures and long black hairs; propleura very minutely, obliquely aciculate and with numerous fine punctures in rows; prosternum thickly, closely punctured, with many long hairs; prothoracic lobe rather sparsely covered with punctures of medium size and black hairs; posterior edge with quite a dense fringe of short, dull-brown hairs; mesonotum black sericeous, with numerous rather coarse punctures and long hairs; the anterior median groove shallow, narrow, smooth, without marked edges in front where it is broadest; lateral margin somewhat reflexed from above the prothoracic lobe to the scutellum; scutellum rather high, rounded, with a very faint median depression; surface with very minute punctures and numerous coarser ones and rather short hairs; postscutellum evenly rounded, without a median groove, rather finely and closely punctured, with hairs longer than those on the scutellum, and with traces of fine transverse aciculation; dorsum of medium segment rather finely, transversely aciculate, with a faint median depression, broadest behind and hardly reaching the anterior end; very finely punctured along the grooves and with a thick covering of short, erect, brownish hairs; dorsum bluntly acute at the fovea, which is subtriangular; posterior end of median segment coarsely punctured and with many long hairs; without aciculations in

the middle but quickly appearing toward the side; side of the median segment obliquely aciculate, more coarsely so anteriorly, the aciculations continued onto the metapleura; the sides are also coarsely punctured and with quite a thick clothing of long hairs; portion of mesopleuron next below the tegula rather coarsely, nearly horizontally aciculate; portion behind the prothoracic lobe very finely, almost vertically aciculate; the area next posterior to this with a faint trace of aciculation, the grooves running obliquely downward and forward; lower part of mesopleuron to the coxæ both minutely, closely, and also coarsely, more sparsely punctured; the whole mesopleuron covered with quite long hair; metapleuron everywhere more or less finely, obliquely aciculate, least evident above the coxæ; coarsely punctured and with long hairs; mesosternum with coarse punctures and long black hairs; petiole black, shorter than the posterior coxæ, straight, with rather fine punctures and medium long hairs.

*Abdomen.*—High, rising nearly vertically from the petiole, broad, ovate, most pointed behind; above: slightly sericeous in certain lights, with scattered punctures, mostly small, except on the last two segments, where they are coarser and closer together; terminal plate rather narrow, its posterior margin rounded oval in outline; beneath: first ventral plate smooth, glistening; ventral surface in general somewhat sericeous, with scattered fine and coarser punctures, mostly on the sides and toward the hinder margins of the plates; second and third plates broadly, slightly emarginate behind; fourth with a few short hairs at the sides; fifth with more hairs, narrower from side to side, its hinder margin with a broad, shallow notch; sixth with its sides rolled upward, showing from above, laterally quite compressed, almost forming an edge along the median line on the hinder four-fifths of its length; thickly, quite coarsely punctured, and with numerous, long, stout hairs.

*Wings.*—Uniformly fuliginous, a little lighter along the outer row of cells, darker just beyond this, then lighter to the margin; with a very faint, violet reflection; fore wings: radial cell bluntly rounded at the tip, scarcely extending beyond the third cubital; second cubital cell high, narrow, about equally wide top and bottom, the first transverse cubital vein bending into the first cubital cell somewhat; hind wing: transverse median vein making less than a right angle with the median, the discoidal veins being almost interstitial at this point; a faint trace only of the cubital vein beyond the transverse cubital; tegulae black, sericeous in front, smooth behind, and dull ferruginous there in some lights; with a few short hairs.

*Legs.*—Coxæ black, sericeous in some lights, with numerous coarse punctures and long hairs; trochanters similar, the hairs less abundant; femora black, the front pair stoutest; all slightly sericeous in places, glistening, with scattered, coarse punctures and hairs of medium size;

the fore femora are slightly grooved beneath, near the tips; tibiae shorter than the femora except the hinder pair which equal their femora in length; sericeous and with numerous rather short, stout spines; tarsi black with a very slight ferruginous tinge; sericeous; fore metatarsus with six or seven (usually six) comb teeth, long and stout; claws ferruginous, blackish at base, with two blunt teeth on the inner edge near the base; hind tibia and base of hind metatarsus strongly brown sericeous behind; hind tibial spine with separated, short, blunt teeth on its outer half; inner contour of hind tibia straight on the outer half but with an abrupt inward crook near the base, seen when the tibia is viewed from behind.

*Male*.—Differs from the female as follows: Mandible with two teeth; edge of clypeus with a less developed sinus; eyes converging downward; the four indentations near the ocelli very faint, particularly the upper pair; median groove of mesonotum with more pronounced edges; petiole longer than in the female, usually as long as the posterior coxae, slightly shorter than the first and second filament segments together, but longer than the first and half the second; second and third ventral abdominal plates not emarginate behind; fourth and fifth brown, silky sericeous, the former somewhat emarginate behind, the latter with a slight, broad emargination; sixth and seventh narrow from side to side, the sixth broadly emarginate, the seventh almost broadly notched rather than excavate; terminal ventral plate very narrow, quadrangular, its hinder margin with a central notch on each side of which it is arcuate; the last two ventral plates nearly enveloped by the last dorsal plate, the hinder margin of which is rounded conical; hind tibiae viewed from behind, with an abrupt inward crook near the base; outer borders of the wings lighter than the remainder.

*Length*.—Females, 19–28 mm.; males, 15–22 mm.

Some variations from the characters described above are met with in certain cases. There seems to be a tendency for portions of the first and second dorsal abdominal plates to show a faint tinge of brown or ferruginous; seven teeth in the metatarsal comb are not uncommon, and in one specimen seen there were seven on one side and six on the other; while pubescence on the face is generally absent, traces of it may often be noted; rarely the petiole is shorter than the hind coxae.

Cresson's description is defective in that not all the males, even in the lot before him when his description was prepared, have a silvery clypeus, and the thorax is not really smooth as he stated, though it does have that appearance when not closely scrutinized.

*Distribution*.—I have seen specimens of this species from the Yakima River and the Grand Coulee, Washington; Crow Heart Butte, Wyoming; Missoula, and Flathead County, Montana; Ormsby County, and Reno, Nevada; from Dakota, Colorado, Nebraska, and Kansas; and

from Coronado, San Diego, Santa Barbara, and Los Angeles County, California. So far as these localities go, the insect seems to belong rather to the transition zone of the Rocky and Sierra and Nevada mountains, and to the more arid portions thereof.

Nothing of the habits of this insect appears to be known and it is not a very common species.

There are three male and two female specimens of a black *Chlorion* (*Palmodes*) in the collection of the American Entomological Society in Philadelphia, which I am unable to distinguish from this species in any way except by size, the males being only 12 mm. and the females 15 and 16 mm., respectively, in length. They were taken in Colorado and "W. T." Whether they are the same or a different species, I must leave for others to determine.

**CHLORION (PALMODES) ABDOMINALIS (Cresson).**

*Sphex abdominalis* CRESSON, male, Trans. Am. Ent. Soc., IV, 1872, p. 211.

*Harpactopus abdominalis* PECKHAMS, Wisc. Geol. and Nat. Hist. Surv., Bull. 2, 1898, p. 174, pl. II, fig. 1.

*Type*.—"One male found on sumach flowers in August. (Coll. G. W. Belfrage.)" This type is now in the National Museum at Washington. A specimen labeled in Cresson's handwriting is in the collection of the American Entomological Society at Philadelphia.

Female type (now first described) in the collection of the Massachusetts Agricultural College at Amherst, Massachusetts.

The following description was prepared from the type specimen.

Black, except the first two segments behind the petiole, and a small portion of the third, which are pale ferruginous; wings uniformly fuliginous; without pubescence; hairs everywhere black.

*Male*.—Head: rather broad; frons somewhat hollowed between the eyes; clypeus quite flat, very closely, minutely punctured and with numerous coarser punctures and long hairs; its anterior edge with a very slightly reflexed, smooth, narrow rim; frons closely, very minutely punctured, and also quite closely covered with coarser punctures, which are not as coarse as those of the clypeus; with numerous black hairs; frontal suture distinct and continuing behind the median ocellus to a transverse, backwardly-arched groove behind the lateral ocelli; this with two oblique grooves inclose the ocelli in a triangle; vertex, occiput, and cheeks with fine punctures and coarser ones, about like those of the frons, but becoming coarser on the lower part of the cheeks; hairs corresponding in size and abundance to the punctures; longest low down on the cheeks; inner margins of eyes converging toward the clypeus; cheeks at their widest part about half the width of the eye as seen from the side; antennæ; scape and pedicel glistening black, with a few short hairs, particularly toward the end of the scape, and a few very fine hairs on the pedicel; first filament segment



longest, somewhat grayish sericeous but less so than the remainder of the filament; second and third filament segments nearly equal in length, fourth and fifth shorter, nearly equal; mandibles black, somewhat tinged with ferruginous near the base of the two teeth; bearing a few black hairs on the posterior face near the base.

*Thorax*.—Collar robust, its posterior face vertical, evenly sloping in front, quite broad from front to rear over its crest, which is evenly rounded from side to side; its surface toward the crest brownish sericeous; surface closely, minutely punctured and also with numerous somewhat coarser punctures and rather short hairs; its side in front of the prothoracic lobe very finely aciculate, the grooves running obliquely forward and downward; prothoracic lobe with small, scattered punctures and rather long hairs; with a dense fringe of short, pale-brown hairs on the hinder border: mesonotum dark-brown sericeous; closely, minutely punctured and with a few somewhat coarser punctures and scattered, short, black hairs; with a narrow median groove extending nearly halfway back, with distinct edges, the groove being a little wider anteriorly; lateral margin reflexed slightly from near the prothoracic lobe up around the tegula and backward to the posterior margin, then inward till the scutellum rises to its level; scutellum higher in its middle than the mesonotum, rounded, with a distinct median groove; its surface closely, minutely punctured and with a few somewhat coarser punctures and a few short, fine hairs; postscutellum without median groove, finely, rather irregularly, transversely aciculate and with rather short hairs; dorsum of median segment finely, transversely aciculate, coarsest anteriorly, closely covered with very short, erect hairs; end of dorsum rounding to a rather blunt point at the fovea, which is small and subtriangular; a median shallow depression is present along the dorsum; hinder end and sides of the median segment rather finely aciculate, the grooves at the sides running obliquely downward and forward and continuing onto the metapleura; stigmatal groove absent; mesopleura rather more coarsely aciculate beneath the tegulae than elsewhere, the grooves nearly horizontal; behind the prothoracic lobe more finely aciculate, the grooves running upward and backward; remainder to the middle coxae closely, minutely punctured and with numerous rather coarse punctures and long hairs; metapleura obliquely aciculate everywhere except around the stigma, coarsest beneath the base of the hind wing; with numerous quite coarse punctures and long black hairs; mesosternum with a median groove; with numerous rather coarse punctures and long hairs; petiole black, slightly curved, about the length of the posterior coxae, bearing many short, black hairs.

*Abdomen*.—First two segments ferruginous, the third slightly so on the sides and behind, above; remainder black; above; first segment rising quite sharply from the petiole, high; its stigma behind the

middle; third segment black except for a ferruginous tinge on its posterior edge and an encroachment of the same color from the preceding segment on its sides (the amount of ferruginous and its extent varies considerably in different specimens); fourth, fifth, and sixth dorsal plates with a tendency to a median carination; these plates very finely, closely punctured, besides a few coarser, scattered punctures; terminal plate tinged with brownish or ferruginous; narrow, evenly rounded behind; beneath; first ventral plate changing from black to pale ferruginous; second, third, and base of fourth pale ferruginous; remainder black; sixth and seventh thickly covered with short, dark hairs; last plate small, poorly preserved in the type; in other specimens narrow, with a median notch on the hinder margin, on each side of which the margin is arcuate; posterior margin of fourth and sixth plates broadly emarginate; the fourth and fifth black, silky sericeous.

*Wings*.—Uniformly fuliginous with a slight violet reflection; fore wing; third cubital cell nearly as long as the radial, which is rounded at its end and more than twice as long as wide; first transverse cubital vein bent slightly into the first cubital cell; second cubital cell high, narrow, its ends about equally wide; hind wing; transverse median vein leaving the median at about right angles to the latter but soon bending inward so that as a whole the two veins make less than a right angle with each other; discoidal not interstitial; cubital only slightly developed and for a very short distance beyond the transverse cubital; tegulae black, somewhat ferruginous behind, slightly sericeous.

*Legs*.—Black, some parts tinged with ferruginous producing a dark, reddish-brown color; coxae closely, minutely, and also coarsely punctured; with long black hairs; trochanters the same, except having fewer coarse punctures and hairs; the hinder pair not sericeous, and reddish brown; femora reddish brown, rather sparsely, minutely punctured and with a few coarser punctures and hairs; tibiae closely, minutely punctured, sericeous in places in some lights, reddish brown; hind tibiae as long as their femora; the others shorter; the hinder pair strongly brownish sericeous behind; hind tibial spur with coarse, blunt, spaced teeth on its outer half; tarsi dark brownish sericeous; claws blackish at base, ferruginous elsewhere.

*Female*.—Differs from the male as follows: Transverse groove behind the ocelli not well marked; mandibles with three teeth; cheeks somewhat broader than in the male; with six long, stout, blunt comb teeth on the fore metatarsus, the first one being often the least developed; tip of abdomen as in *rufiventris*; petiole a little longer than the second and half the third hind tarsal segments; nearly all of the third abdominal segment ferruginous.

The amount of ferruginous on the abdomen varies in different specimens, being much more in some than in others. Except for the presence of black, I can find no characters which will separate this

species from *rufiventris*, and it is not improbable that a larger series will show that the two are merely color varieties.

*Length*.—Females, 18–20 mm.; males, 14–17 mm.

This interesting species appears to be widely distributed but far from common. I have seen specimens from Texas, Florida, New Mexico, California, Georgia, Virginia, and New Jersey; from Ludlowville, New York; Michigan, Wisconsin, and Minnesota, and it is recorded from northwestern Illinois as well.

On so many of the specimens only the State is given that I find it impossible to make out any relation to the life zones for the distribution of the species.

#### CHLORION (PALMODES) RUFIVENTRIS (Cresson).

*Sphex rufiventris* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 211.

*Harpactopus rufiventris* PATTON, female, Bull. U. S. Geol. and Geogr. Surv., V, 1880, p. 354.

*Harpactopus rufiventris* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 383.

*Sphex rufiventris* COQUILLETT, Rept. U. S. Dept. Agr., 1885, 1886, p. 299.

*Types*.—Two females, now in the collection of the National Museum at Washington. Cat. No. 1690, U.S.N.M.

Male type: One specimen from Texas, in the collection of the National Museum; now first described.

The following description, prepared from the types, is followed by comments obtained from the study of other specimens:

Body to and including the petiole, black; abdomen ferruginous; legs black; wings fuliginous.

*Female*.—Head rather large, quadrangular, hollowed in front between the eyes when viewed from above; clypeus short, broad, extending below the eye nearly half the width of the eye; its surface almost flat, the anterior margin very slightly reflexed, smooth; the remainder very closely, minutely punctured and with numerous coarser punctures and moderately long, black hairs; frons similarly marked, the coarser punctures not as coarse and nearer each other than on the clypeus; its surface almost without hairs (worn off!); frontal suture distinct; a short distance obliquely backward from each lateral ocellus there is often a puncture larger than its neighbors, showing best in worn specimens; surface of vertex marked like the frons, its highest point about opposite the hinder edge of the eyes; cheeks broad, nearly the width of the eye, broadest in the middle, minutely, closely punctured and also with coarser punctures, particularly below; with numerous long, black hairs, longest below; inner margins of eyes parallel; antennæ; scape black with a ferruginous tinge, somewhat glistening, with a few short, black hairs and two or three stout ones on the inner side at the tip; very minutely punctured; pedicel short, black; filament black, particularly toward the base, grayish sericeous in some

lights; its first segment about one and a half times the length of the second; third segment of the filament slightly shorter than the second, about one-fifth longer than the fourth; mandibles long, stout, blackish, streaked longitudinally with ferruginous, three-toothed, the middle tooth rather more slender than the anterior one; with a row of punctures from the base to the base of the anterior tooth and another along the ventral face, with a few black hairs on the posterior side.

*Thorax.* — Collar large, thick from front to rear, its anterior face not vertical, though about at right angles to the portion of the neck nearest; evenly rounded from side to side and somewhat appressed against the mesonotum; its surface blackish sericeous, closely, minutely punctured, and with a few somewhat coarser, scattered punctures; prothoracic lobe with a few, small, scattered punctures and a well developed, dense fringe of short, pale brown hairs on its posterior edge; near its base is a trace of aciculation, the grooves running downward and backward; this is more pronounced on the propleuron just in front, and on the mesopleuron just above the lobe and below the tegula, where the grooves run backward but only slightly downward; mesonotum very minutely punctured and also with a few coarser punctures and scattered, short hairs; its median groove about one-fifth as long as the plate itself, deep, narrow, sharp-edged; a faint line extending backward from it; lateral edges with a slightly reflexed rim from in front of the tegulae backward, then inward to where the scutellum rises to the level of the mesonotum; scutellum rounded, higher than the mesonotum, with a median groove; its dorsal surface minutely punctured and with a few slightly coarser ones as well; at the sides behind, it is very finely, obliquely aciculate; post-scutellum narrow, evenly rounded, finely, transversely aciculate; median segment dorsum forming a rounded point at the small, triangular fovea; its surface more coarsely, transversely aciculate than the plates anterior to it; a faint median depression is present near the middle and hinder end, but between these places it is still fainter, and in front there is no trace of it; the aciculation is coarsest in front; posterior end of median segment slightly, transversely aciculate, with numerous rather large punctures and long hairs; sides of median segment closely, rather finely aciculate and with numerous hairs of medium length; stigmatal groove absent and the aciculations continued directly onto the metapleura which are finely aciculate, the grooves running forward and downward; mesopleuron behind the prothoracic lobe very finely aciculate, the grooves running forward and downward; the lower portion to the mesocoxae roughened, with a faint trace of nearly vertical aciculation and with numerous, short, black hairs; portion of metapleuron next the base of the hind wing more coarsely aciculate than elsewhere; mesosternum with a pronounced median longitudinal ridge, minutely, closely punctured and also with numerous coarse punctures and long hairs; petiole



black, sometimes with a slight ferruginous tinge, nearly straight, as long as the posterior coxæ, with a few scattered punctures and black hairs.

*Abdomen*.—Quite high above the petiole, elongate, pointed at both ends, rather sharply bent beneath between the first and second segments, yellow ferruginous varied with darker in places, glistening; above; stigma of first dorsal plate behind the middle; a few scattered punctures showing, more abundant posteriorly; fourth plate somewhat broadly emarginate behind; sixth plate rather long and narrow, rounded behind; with a very few short brown or black hairs at the sides; beneath; similar to above, but rather darker and somewhat more punctured; all the plates more or less emarginate behind; last plate laterally compressed, almost carinate medially, long, and with quite long, black hairs; the plate projecting beyond the dorsal plate.

*Wings*.—Uniformly fuliginous, with a slight yellowish tinge and a violet reflection; fore wing; radial cell broadly rounded at tip, extending no farther than the third cubital cell; first transverse cubital vein bent slightly into the first cubital cell; second cubital cell high, narrow; hind wing; transverse median vein making less than a right angle with the median, though leaving it at right angles; discoidal vein almost or quite interstitial; cubital vein almost obsolete beyond the transverse cubital; tegulæ black with a faint ferruginous tinge, slightly sericeous.

*Legs*.—Black, more or less tinged with dull ferruginous; coxæ closely, minutely, and also coarsely punctured; with numerous long hairs; trochanters similarly marked but the coarse punctures and hairs are less numerous and the latter are shorter; femora rather sparsely, minutely punctured and with a few coarser punctures and hairs; more distinctly tinged with ferruginous; tibiæ closely, finely punctured, sericeous in places in some lights; hind tibiæ as long as their femora; the others shorter; the hind tibiæ strongly brownish sericeous behind; hind tibial spur with coarse, blunt, spaced teeth on its outer half; fore metatarsi with six long, stout comb teeth; tarsi finely, closely punctured; claws with two teeth on the inner edge near the base; blackish at the base, ferruginous elsewhere; the outer tooth may be of either color.

*Male*.—Differs from the female as follows: Clypeus with the central lobe less produced; inner margins of the eyes slightly converging; frons, vertex, and cheeks with more of the coarser punctures; as a whole more brownish sericeous and more hairy; the next to the last ventral abdominal plate with a broad, shallow notch; its posterior third very closely, finely punctured and with coarser punctures mingled here and there with the others, and thickly covered with very short, dark hairs; terminal plate very slightly rounded behind, its surface punctured and with hairs like the posterior third of the plate in front;

last four dorsal abdominal plates showing more or less black, the two anterior ones somewhat mottled with ferruginous and somewhat sericeous.

*Length*.—Females, 16–23 mm.; male (only one seen), 19 mm.

This species like the last has a wide range, but is not at all common. I have seen specimens from Texas, California, Colorado, Kansas, and “Can.”

The absence of black on the abdomen seems to be the only character which separates this species from *abdominalis* and in some cases the hinder part of the abdomen is much darker than in others though it could hardly be termed black. It is very probable that with a larger series the two species will prove to be the same, in which case the name *abdominalis* will hold by “priority of place.”

The following species is also very closely related to this, and may prove to be only a variety of it:

CHLORION (PALMODES) PRÆSTANS (Kohl).

*Sphex* (*Palmodes*) *præstans* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 323.

*Type*.—Described from one (?) specimen in the Hamburg Museum, taken in California.

Large, black except for the pale ferruginous, almost yellow, abdomen. Wings strongly tinged with yellow. Hairs black.

*Female*.—Head black, large, almost oblong when viewed from above, slightly excavate between the eyes; clypeus broad, slightly convex, its anterior margin with pronounced lateral sinuations and a large central, truncated lobe; the anterior margin reflexed and smooth; the remainder with numerous coarse punctures and long, stout, black hairs; frons excavated laterally, with an evident frontal suture; its surface with numerous rather coarse and many very minute punctures and quite long hairs; frontal suture continued behind the median ocellus to a slightly arched transverse groove; an oblique groove passes from the frontal suture to the end of the transverse groove on each side of the ocelli, thus inclosing the latter in a triangle; distance between the lateral ocelli about equal to that from the ocelli to the eye; vertex sparsely black pubescent, and with quite numerous, long hairs; cheeks quite wide above, narrowing rapidly below; with numerous long hairs; eyes parallel, not converging below; antennæ black, the filament grayish-sericeous; scape and pedicel dull, faint ferruginous beneath, the former with a few short, rather stout hairs; relative lengths of the filament segments  $\frac{1}{3}$ ,  $\frac{2}{1}$ ,  $\frac{3}{6}$ ,  $\frac{4}{0}$ , mandible black, long, stout, three toothed, the middle tooth the smallest, with a groove from the base nearly to the middle tooth on the anterior face, from which arise a few hairs; a slight groove is also present near the ventral edge.

*Thorax*.—Neck rather short, quite stout, making nearly a right angle with the collar; collar broad, thick; its dorsal edge rounded both from

front to rear and laterally; its surface quite thickly, coarsely punctured and with many long black hairs; neck above faintly, transversely aciculate; sides of collar in front of the prothoracic lobe almost vertically aciculate behind, obliquely so in front; this portion with a nearly vertical, smooth, narrow ridge near its middle, opposite the lower half of the prothoracic lobe; prothoracic lobe with many minute and scattered, medium-sized punctures; with long, black hairs and a fringe of short, brownish ones on the posterior margin; propleura and prosternum similarly punctured; mesonotum with a reflexed edge from the prothoracic lobe back; with a median groove, narrow (almost an impressed line only) except near the front; surface of mesonotum with medium-sized punctures and many minute ones, with numerous hairs and sparse, black pubescence; scutellum rather rounded in the middle, not higher than the mesonotum, slightly and rather broadly depressed from front to rear along the middle line, with rather scattered punctures and a few hairs; postscutellum narrow, evenly rounded, without a median, impressed line or groove; with rather fine punctures and short hairs; dorsum of median segment rather coarsely, transversely aciculate, the aciculations continued over the sides and onto the metapleura; with a median depression, broader behind, near the fovea; posterior end forming a marked angle with the dorsum which in profile shows a fine, brownish, erect pubescence; posterior end rather more finely aciculate than the dorsum, covered with long hairs; sides of the median segment obliquely aciculate and punctured; metapleura and upper, posterior part of the mesopleura (under the hind wing) obliquely, coarsely aciculate and well clothed with long hairs; mesopleura closely, coarsely punctured and thickly clothed with hair; meso- and metasterna similarly clothed; petiole black, with a dull, ferruginous tinge, quite straight, curved a little at about its posterior third, sparsely punctured and with a few scattered hairs; as long as the second and half of the third hind tarsal segments together.

*Abdomen*.—Pale ferruginous yellow, glistening; rising sharply to a point high above the petiole; rounded in front, long pointed behind; above with a few minute, scattered punctures; last dorsal plate arched rather like a cap, its posterior margin rounded, compressed at the sides, with the punctures somewhat more abundant than in front; below; first ventral plate dark anteriorly, gradually becoming pale ferruginous; a trace of a transverse row of minute punctures in front of the hinder margin of each segment, with small, black hairs arising from them; fourth and fifth plates slightly emarginate behind; sixth plate laterally compressed, its tip narrowly rounded and with numerous long hairs near the middle, following around toward the lateral edges till they lie on the upper side of the body, close to the tip of the shorter dorsal plate.

*Wings.*—Hyaline, strongly tinged with yellow to beyond the ends of the cells; the outer margin of the fore wings slightly fuliginous; fore wing; outer end of radial cell broadly, quite evenly rounded; third cubital cell extending nearly to the end of the radial; the larger veins ferruginous, the smaller ones yellow; hind wing; transverse median vein somewhat curved, making as a whole less than a right angle with the median; discoidal vein not interstitial; cubital vein obsolete beyond the transverse cubital which passes obliquely forward and outward; tegulae black with a faint ferruginous tinge; slightly black pubescent in front.

*Legs.*—Black, with a faint ferruginous tinge, particularly toward the tips; fore coxae large, with coarse, scattered punctures and long, black hairs; fore trochanters with a few such; fore femora short, stout, glistening; with a few black hairs; fore tibiae with numerous short, stout, black spines and scattered punctures; fore metatarsus with seven quite long, stout, rather bluntly ending comb teeth alternating with shorter ones; on the underside is a band of minute, erect, very short, brown hairs; rest of the fore tarsus with many long, stout, blunt spines; these segments and the claws distinctly ferruginous; claws with two blunt teeth near the base on their inner margin; hind tibia longer than its femur; hind tibial spine with coarse, spaced teeth on its outer half.

*Male.*—Unknown.

*Length.*—Female, 21–25 mm.

This description was prepared from two specimens marked "Mt. Shasta dist. Califor." and now in the American Museum of Natural History in New York. A third specimen there, bearing the same locality label has only six comb teeth, somewhat fuliginous wings, a more decidedly ferruginous abdomen, a trace of a ferruginous band across the mandible, the radial cell more squarely ended, and with a trace of the cubital vein beyond the transverse cubital in the hind wing.

This rare species seems to be very limited in its distribution, so far as the few specimens now known go, it having been taken only in California and Beaver canyon, Utah (one specimen in the Brooklyn Museum). Whether it is a good species or only a marked variety of the last can hardly be determined without a larger series for study.

Subgenus **PRIONONYX** Dahlbom (genus).

*Priononyx* DAHLBOM, Hym. Eur., I, 1845, p. 439.

*Harpactopus* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 264.

*Gastrosphaeria* A. COSTA, Fauna Napoli. Sphecid., 1858, p. 10.

*Harpactopus*—*Gastrosphaeria*—*Priononyx* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 113.

*Harpactopus* KOHL, Ann. natur. Hofmus. Wien, XI, 1896, p. 319.

*Type.* *Chlorion (Priononyx) thomæ* Fabricius, Syst. Ent., 1775, p. 346.



Claws with from two to six teeth near the base of their inner border. Median segment without a stigmal groove. Stigma of the first dorsal abdominal plate behind its middle. Inner margins of the eyes parallel in the female; more or less convergent in the male. Clypeus somewhat rounded anteriorly, usually with a median depression or notch. Second cubital cell higher than broad. Tarsal comb present in the female. Comb teeth of the hind tibial spine spaced, tooth-like. Last ventral abdominal plate of the female arched but without a median longitudinal ridge. Ventral abdominal plates of the male flat; those of the fourth and fifth segments silky sericeous. Abdomen rising sharply behind the petiole and to a considerable height, particularly in the female. First and second segments of the filament of the antenna short in the male, together not much longer than the first segment in the female. (Plate IX, figs. 15, 16; Plate X, fig. 24.)

The genera *Priononyx*, *Harpactopus*, and *Gastrosphacria* appear to have been established by their authors mainly on the number of teeth present on the tarsal claws. This character is too restricted, however, as many forms which are widely separate would be brought into near relationship if this were the only criterion, while nearly related species as shown by a comparison of all their characters, but which differ in the number of claw teeth, would be widely separated. Kohl has already called attention to the unnaturalness of these groups and has united them, giving practically the description above. He has selected the name *Harpactopus* for the group, but as *Priononyx* was used nearly ten years earlier I prefer that name, for in either case the name does not carry its original significance, the group having been redefined and its limits changed.

#### CHLORION (PRIONONYX) FERRUGINEUM (Fox).

*Sphex* (*Priononyx*) *ferrugineus* Fox, female, Ent. News, III, 1892, p. 170.

*Type*.—One female from So. Cal. (so the label on it states) now in the National Museum in Washington. (Type, Cat. No. 1867, U.S.N.M.)

Male cotypes (now first described): Five males; two taken at Congress Junction, Arizona, July, by F. H. Snow, and now in his possession; one taken at Albuquerque, New Mexico, and in the collection of Dr. W. H. Ashmead; one from Los Angeles County, California ("coll. Coquillett"), in the United States National Museum; and one from Rincon, New Mexico, taken July 5, now in the collection of the Massachusetts Agricultural College in Amherst, Massachusetts.

The following description was prepared from the female type:

Slender; head large; body in general pale ferruginous, with considerable dull white to yellowish, long pubescence and hairs; wings hyaline.

*Female*.—Head broad, slightly excavate in front, well rounded behind; clypeus ferruginous, somewhat convex, quite densely covered with yellowish-white pubescence and long hairs; anterior edge making quite a smooth, regular curve, and slightly or not at all reflexed; frons depressed along its middle, ferruginous, densely yellowish-white pubescent as far up as opposite the posterior ocelli; area around the ocelli darker than the rest of the frons, more or less black; distance between the posterior ocelli about equal to their distance from the eye; a groove extends backward from the median ocellus between the lateral ones, along which the ferruginous color is present; vertex and cheeks ferruginous, with rather sparse, whitish pubescence on the cheeks, which are broad above but taper rapidly downward to the level of the lower edge of the eye, where they suddenly widen, forming a broad articulation for the mandible; the tapering part of the cheek bears numerous long, white hairs; eyes black, large, converging somewhat toward the clypeus and without a projection toward the middle at the vertex; antennæ; scape, pedicel, and proximal part of the first filament segment ferruginous; remainder black; scape with a few short, whitish hairs; relative length of filament segments  $\frac{1}{10}$ ,  $\frac{2}{10}$ ,  $\frac{3}{10}$ ,  $\frac{4}{5}$ ; mandibles pale ferruginous to yellowish, their tips dark; two toothed, the teeth quite blunt (in the type), not reaching the base of the other mandible; with a row of pale hairs on the hinder surface.

*Thorax*.—Ferruginous; neck slender, short; collar broad from front to rear, its anterior face strongly convex laterally and quite so vertically; its dorsal edge broad both laterally and from front to rear; the anterior face and dorsal edge whitish pubescent, less so at the sides; prothoracic lobe large, quite densely pubescent, with a smooth, rounded elevation at its base above; propleuron and prosternum sparsely covered with short, whitish hairs; mesonotum ferruginous, slightly darker behind, quite densely pubescent except on a pair of parallel, rounded ridges arising near the front of the plate and extending backward, which are unclothed; mesopleura and mesosternum ferruginous, the former quite densely, whitish pubescent; the latter with a few short, scattered hairs; scutellum elevated, somewhat impressed in the middle but hardly bituberculate, slightly pubescent, ferruginous; postscutellum ferruginous, narrow, densely pubescent; median segment dorsum with a densely pubescent, yellowish-white band along its middle, its sides black, obliquely aciculate and naked; angle between the dorsum and the posterior end slight, the end and sides of the median segment densely pubescent; stigmal groove absent; metapleura ferruginous, anteriorly coarsely, obliquely aciculate and punctured; behind, nearer the hind coxæ, pubescent; petiole ferruginous, slightly darker at its base, long, slightly bent upward, naked; as long as the hind metatarsus.

*Abdomen*.—Ferruginous, rising sharply from the petiole, laterally compressed, elongate posteriorly; above; first two plates lighter, the

others rather darker, glistening, with very minute, scattered punctures and a minute hair here and there; stigma of the first plate near the hinder edge; terminal plate elongate, evenly rounded behind, with rather coarse punctures and hairs near its hinder edge; beneath; ferruginous, darker in some places than in others, the terminal plate long and conical, rounded at its tip and bearing a few hairs.

*Wings*.—Hyaline, with brownish veins; fore wing; radial cell rather broad, rounded at its tip; second cubital cell higher than broad; third cubital not reaching the end of the radial; third transverse cubital vein joining the radial cell quite close to the second; first recurrent vein joining the first cubital cell close to the first transverse cubital vein, sometimes even interstitial with it; hind wing; transverse median vein somewhat curved, but as a whole making an acute angle with the median vein; anal vein nearly or quite obsolete beyond the transverse median vein; discoidal vein leaving the cubital some distance behind the transverse median, and quite faintly developed; cubital vein obsolete beyond the transverse cubital, and the radial vein extends but a short distance beyond the latter; tegulae pale ferruginous, white pubescent, particularly on the anterior margin.

*Legs*.—Ferruginous, the middle and hind pairs long; fore coxæ, trochanters, femora and tibiæ with scattered yellowish-white hairs, the femur with a row of them along a faint groove beneath; fore femora longer than the fore tibiæ, stout, curved; fore tibiæ with a fringe of quite long hairs on the inner and outer sides; fore metatarsus with a tarsal comb consisting of a fringe of very long, slender hairs; the other tarsal segments with numerous long hairs and slender spines; outer side of middle and hind coxæ pubescent; middle femur straight, slightly longer than its tibia, smooth; tibia with small, whitish spines scattered along its surface, its two inner apical spines black; middle tarsi spiny, posterior coxæ somewhat pubescent externally; femur shorter than the tibia, the former slightly pubescent above; tibia pubescent behind, its inner contour straight, its apical spines black, the comb consisting of coarse teeth; tarsi spiny, claws of all the legs ferruginous, with five blunt teeth and the rudiment of a sixth at the base, the inner two (besides the rudimentary one) and the empodium black. (Plate IX, fig. 20.)

The pubescence in many cases is decidedly golden; the amount of black around the ocelli varies, that described above being about an average; the mesonotum is frequently darker than in the type, in some cases being almost black; in worn specimens the middle of the dorsum of the median segment is seen to be black, and the dorsum as a whole tends to be darker than in the type; sometimes the anterior edge and corners of the scutellum are dark like the mesonotum; the bases of the claws tend to be dark; neither recurrent vein of the fore wing is always interstitial; if not it joins external to the transverse cubital

rather than internal; the anal vein sometimes continues a short distance beyond the transverse median; the main (terminal) tooth of the mandible is very long in unworn examples, reaching nearly to the base of the other jaw, and is black, making nearly half the mandible black; there are three teeth to the mandible, the middle one the shortest; the hind coxæ are sometimes pubescent on all sides, the middle pair slightly so; a distinct frontal suture is sometimes evident.

*Male*.—Differs from the female as follows: Body ferruginous but with more dark and black; anterior edge of clypeus slightly reflexed; scape of antenna varying from dark ferruginous to black varied with ferruginous; rest of antenna black except the pedicel and part of the first filament segment which may be somewhat ferruginous; first filament segment the longest, the relative proportions being  $\frac{1}{11}$ ,  $\frac{2}{11}$ ,  $\frac{3}{11}$ ,  $\frac{4}{11}$ ; mandible dark, but not black, except the tip and base of the posterior tooth; two toothed; thorax varying in color from reddish ferruginous to nearly black; petiole and legs darker than in the female, often nearly or quite black; pubescence everywhere clear white; hinder margin of the third, and the fourth and fifth ventral abdominal plates black, silky sericeous; the others posterior are ferruginous and slightly pubescent; last dorsal abdominal plate conical with rounded tip; margin of fore wing faintly fuliginous.

*Length*.—Females, 15–20 mm.; males, 10–19 mm.

This beautiful and interesting species has been taken in southern California, chiefly in Los Angeles County; in Arizona, and in New Mexico. The pubescence seems to be more yellow in the California specimens than in those taken elsewhere. I have studied specimens captured at Albuquerque, New Mexico; Congress Junction, Arizona, July; Bill Williams Fork, Arizona, August; and Rincon, New Mexico, July 5, taken on mesquite.

This insect is far from being a typical *Priononyx*, and for a long time the writer was inclined to place it in the subgenus *Paraspheex*. The clypeal characters, the general form of the body and its color, and that of its pubescence, all suggest a close relationship to *Paraspheex*, which is confirmed by the first filament segment of the male antenna, which is the longest, while in the species of *Priononyx* this is not the case in that sex. No representative of *Paraspheex* has thus far been discovered in the New World, and as in some regards (the presence of six claw teeth instead of three or four, for example) this species fails to meet the characters designated for *Paraspheex*, it seems best to retain it in *Priononyx*, though it is one of those intermediate forms already alluded to which prevent the groups termed subgenera in this paper being given full generic value.

There is an excellent figure of this insect in The Insect Book, by Dr. L. O. Howard, on Plate XI, fig. 9.



**CHLORION (PRIONONYX) STRIATUM (Smith).**

? *Pepsis johannis* FABRICIUS, Syst. Piez., 1804, p. 208.

? *Sphex doumerci* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 357.

*Priononyx striata* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 266.

*Sphex (Harpactopus) striatus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 356.

? *Sphex (Priononyx) larma* CAMERON, Ann. and Mag. Nat. Hist., 6th ser., XIX, 1897, p. 370.

*Sphex striatus* DUCKE, Zeits. f. Syst. Hym. u. Dipt., I, 1901, p. 241.

Black, except the abdomen, which is pale ferruginous; wings dark fuliginous, with a violet or even greenish reflection at certain angles; hairs of the body in part dirty white; large, robust insects.

*Female*.—Head large, broad, having a squarish oblong outline when viewed from above, the cheeks being quite wide; frons somewhat excavated between the eyes; clypeus large, considerably arched, with an anterior reflexed margin, in the center of which is a notch, above which is a median depression of some considerable depth; surface with numerous coarse and many fine punctures; more or less dull whitish pubescent, with numerous long, coarse, black (and a few whitish?) hairs; frons with a pronounced frontal groove; sparsely whitish pubescent at the sides; with an elongate, slightly depressed area above each antennal attachment; surface quite closely, minutely punctured; ocelli inclosed by furrows marking a triangular ocellar area; frontal groove continued behind the anterior ocellus a short distance; top of head some distance behind the ocelli; lateral ocelli about equidistant from each other and from the eyes; vertex minutely punctured, bearing fine black pubescence and a few long, black hairs; occiput similarly clothed, but with quite numerous whitish hairs also; cheeks not quite as wide as the eye, viewed from the side, not narrowing quickly below, with many long, dull white and black hairs, particularly below; eyes parallel at their inner margins; antennae black, the filament grayish sericeous; scape black, with short black hairs, particularly at the tip on the inner side; relative lengths of the filament segments  $\frac{1}{3.5}$ ,  $\frac{2}{2.4}$ ,  $\frac{3}{2.6}$ ,  $\frac{4}{2.1}$ ,  $\frac{5}{2.0}$ ; mandibles black, with a dull ferruginous tinge near the base of the teeth; stout, grooved on the anterior face from the base to near the base of the anterior tooth, with a smaller, longer groove beneath, and with long black hairs arising from the anterior groove and the posterior face; the mandible is long, almost reaching the base of its mate.

*Thorax*.—Stout, black; top of the neck and lower part of anterior face of the collar with a few minute punctures; glistening; remainder of that face and the dorsal edge whitish pubescent and bearing a few long, whitish hairs; the dorsal edge evenly rounded; rather closely appressed to the mesonotum; sides of the collar and front of the prothoracic lobe with coarse, oblique ridges, finer anteriorly; a flattish tubercle at the base of the dorsal part of the prothoracic lobe is smooth

and glistening, and the side of the collar above this tubercle is black pubescent; prosternum coarsely, quite closely punctured, and with many long, dull white hairs; mesonotum with its lateral and hinder margins from the prothoracic lobe back strongly reflexed, with parapsidal lines evident and with a distinct and rather broad median groove, broadest anteriorly; surface of the mesonotum marked with well-developed ridges, which near the median groove run parallel to it, but farther out diverge backward and near the anterior edge of the plate become almost transverse, the ridges seemingly radiating from two centers, one on each side of the central median groove and close to the anterior edge of the plate; scutellum high in the middle, with a median groove making it distinctly bituberculate; the surface with minute punctures and with faint, oblique aciculations at the sides; the tips of the tubercles somewhat glistening; postscutellum narrow, minutely punctured, quite closely covered with short, dull white hairs; median segment dorsum rather coarsely, transversely striate, with rows of medium sized punctures between the striæ; its surface quite thickly covered with long, delicate, whitish hairs; with a median depression along the entire length of the plate; angle between the dorsum and the posterior end of the median segment quite sharp, but greater than a right angle; the end coarsely, transversely striated; fovea small, circular; posterior end clothed like the dorsum; an impressed line extends backward at the side of the dorsum from the postscutellum to the stigma, but is absent from there to the fovea; from above the posterior coxæ a ridge extends forward and slightly upward toward the base of the hind wing, below which the body is narrower than above the ridge; the striæ of the dorsum of the median segment are continued laterally over this ridge onto the metapleura, where they run obliquely forward and downward, being strongest near the ridge; mesopleura coarsely striated, the striæ curving around the front of the mesocoxæ and extending a short distance transversely on the mesosternum, which is coarsely punctured; more anteriorly on the mesosternum the striæ are more radiating in arrangement; petiole black, straight, rather sparsely, minutely punctured, and with numerous short, whitish hairs; longer than the second hind tarsal segment.

*Abdomen.*—Pale ferruginous yellow, darker at the sides and behind than on the first two segments; stout; elongate pointed behind, rather more blunt in front; rising high and nearly at right angles from the petiole; above; glistening, minutely whitish sericeous at the sides of the second and more posterior segments; surface with a few scattered punctures, becoming more evident on the hinder segments; terminal plate with a few long black hairs, its hinder end rounded conical; beneath; color as above, with a tendency to blackish on the posterior lateral angles, and with the posterior margins of the plates slightly

emarginate; posterior half of the terminal plate with noticeable punctures and black hairs.

*Wings.* Dark fuliginous with violet or even greenish reflection in some lights; fore wing; end of radial cell rounded; end of third cubital cell extending as far as the end of the radial; second recurrent vein joining the cubital near the second transverse cubital; hind wing; transverse median vein nearly straight, at right angles with the median; the discoidal vein not interstitial; cubital vein with only a short stub beyond the transverse cubital which joins both the cubital and radial nearly at right angles and is but slightly curved; the radial vein well developed beyond the transverse cubital; tegulae black, slightly whitish pubescent in the center.

*Legs.*—Long, black; fore coxae and trochanters coarsely punctured and bearing quite stout, black hairs; fore femora glistening, with a row of stout hairs in a longitudinal internal groove and shorter ones on the opposite side and above; fore tibiae with stout spines and with long hairs on the inner surface; fore tarsi with stout spines, particularly at the tips of the segments; fore metatarsus with eight comb teeth; tarsus whitish sericeous above; middle and hind tarsi coarsely punctured (but less so than the fore tarsi); with black hairs; sparsely whitish sericeous; trochanters the same; middle and hind femora sparsely, finely punctured, with scattered, black hairs; glistening; middle and hind tibiae glistening, with scattered, rather short, stout spines and a few fine hairs; the hind tibiae heavily brownish sericeous behind; hind tibial spine with coarse, blunt, spaced teeth; claws with five teeth, the two outer and the outer part of the claw with a slight ferruginous tinge. (Plate IX, fig. 19.)

In some cases there is no dark shade on the abdomen; the pubescence on the clypeus and frons is more golden; there is a trace of whitish pubescence on the prothoracic lobe near the fringe; the anterior tooth of the mandible is not sharply separated from the middle one; the mesonotal striae nearest the sides of the plate are nearly parallel to the edge of the plate, leaving an unstriated triangle in front; the wings may be strongly fuliginous and the abdomen a deeper ferruginous; and two punctures between and behind the eyes and ocelli may be quite strongly marked.

*Male.*—Differs from the female as follows: Clypeus and frons more evidently pubescent; with a broader depression above the notch; the large puncture behind the line from the posterior ocelli to the eyes less marked; cheeks narrower in proportion to the width of the eye; more rapidly tapering below; relative lengths of filament segments  $\frac{1}{2}$ ,  $\frac{2}{2}$ ,  $\frac{2}{2}$ ,  $\frac{4}{5}$ ,  $\frac{5}{4}$ ; occasionally a black spot may be seen on the dorsal surface of the abdomen; sixth ventral abdominal plate with its hind corners rounded, its hinder margin broadly, slightly emarginate; both surfaces of the abdomen rather coarsely whitish sericeous; the first trans-



verse cubital vein of the fore wing is usually quite oblique to the second; legs more sericeous than in the female; inner tooth on the claw smaller than the others.

*Length.*—Females, 18–28 mm.; males, 18–26 mm.

This insect, which is the largest known American *Priononyx*, has not hitherto been reported from North America, the localities given for previous captures being Brazil and Venezuela. I have studied specimens from the last-named country and also from Cordoba, Argentina, and three (a female and two males) taken at Bill Williams Fork, Arizona, in August, by Prof. F. H. Snow, which bring this species within the geographical limits of this paper. If *Priononyx lærma* Cameron should prove to be the same, Mexico could be added to the habitat, thus giving a continuous northern extension from Venezuela to Nevada for the species, as in the collection of the American Entomological Society is a female 28 mm. long, from Nevada, marked "*magna* Cr." (a manuscript name), and a male 22 mm. long, from Mexico.

#### CHLORION (PRIONONYX) ATRATUM (Lepeletier).

*Sphex labrosa* HARRIS, Cat. An. Mass., 2d ed., 1835, p. 588, (*nomen nudum*.)

*Sphex atrata* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 355.

*Priononyx atrata* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 266.

*Priononyx atrata* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 213.

*Priononyx brunnipes* CRESSON, male, Trans. Am. Ent. Soc., IV, 1872, p. 213.

*Priononyx atrata* COQUILLETT, Rept. U. S. Dept. Agr., 1885, 1886, p. 298.

*Sphex* (*Harpactopus*) *atratus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 357.

*Priononyx atrata* COQUILLETT, Ins. Life, VII, 1894, p. 228.

*Priononyx atrata* PECKHAMS, Wisc. Geol. and Nat. Hist. Surv., Bull. 2, 1898, p. 171, pl. xiv, fig. 4.

The type of *brunnipes* Cresson is Cat. No. 1691 of the U. S. National Museum in Washington. It is not in good condition, the interior having been eaten out by museum pests and the terminal abdominal plates destroyed.

*Female.*—Robust, black; with fuliginous wings having a violet reflection.

*Head.*—Stout, quadrangular when viewed from above, the frons somewhat excavated between the eyes; clypeus broader than long, arched in the middle, its anterior margin extended laterally beneath the eyes to the base of the mandibles; turning abruptly downward near their inner margins, then running nearly straight across the front, this margin bearing quite a deep notch at its middle, above which is a pronounced depression; surface beneath the eyes smooth, as is also the slightly reflexed rim; the remainder very closely, minutely, and also sparsely, coarsely punctured, with more or less white pubescence and long, rather stout black hairs; near the margin of the central notch the clypeus is tinged with ferruginous; frons minutely punctured and with a few coarser, scattered punctures; sparsely white pubescent at



the sides, slightly black sericeous in the middle, and with a few rather short black hairs; median suture developed, with a noticeable, large puncture near its middle; an oblique suture outside the ocelli joins the frontal suture with a transverse one behind and continuing backward, ends at a faint puncture bearing a macrochaeta; vertex and cheeks minutely, closely punctured, sericeous, almost glistening, almost without coarser punctures and hairs except along the border of the occiput and low down on the cheeks, where both become quite abundant; top of the vertex located behind the posterior edge of the eyes; cheeks quite robust, in their widest place wider than half the width of the eye; antennæ black, the filament slightly olive sericeous in some lights; scape with a few scattered punctures and hairs, particularly on the inner side near the tip; pedicel short, black; first segment of the filament longest; relative lengths of filament segments  $\frac{2}{22}$ ,  $\frac{2}{14}$ ,  $\frac{3}{14}$ ,  $\frac{4}{13}$ ; mandibles stout, blackish at base, tinged with ferruginous near the bases of the teeth and peripherally, varying in amount; with numerous longitudinal grooves and three teeth, the anterior one smallest and close to the median one; with a fringe of long black hairs behind and another in front.

*Thorax*.—Collar with its front and hind faces nearly vertical, the latter quite closely appressed against the mesonotum; lower part of the anterior face smooth, glistening; above this slightly blackish sericeous, with close, minute punctures and more scattered ones and often with a few fine, transverse aciculations; this portion and the dorsal edge sometimes thinly whitish pubescent and bearing black hairs; sides of the collar in front of the prothoracic lobe with fine oblique aciculations except on a small round hump in front of the upper edge of the lobe, which is smooth; prothoracic lobe with a continuation onto its upper part of the aciculations from in front; smooth below, with a few long black hairs and with a dense fringe of short brown hairs on its posterior edge; prosternum with a strongly developed median groove, coarsely punctured, and bearing numerous, quite long, black hairs; mesonotum with a median impressed line extending the entire length of the plate, widest, and with faint edges anteriorly; the surface of the plate blackish sericeous with close, minute punctures and a few scattered, coarser ones and short, black hairs; lateral margin somewhat reflexed from in front of the tegulae, where there is a trace of aciculation, backward and then inward to where the scutellum rises to its level; scutellum high, rounded, sometimes slightly constricted in the middle in front and behind, giving it a slight dumb-bell shaped outline, its sides and anterior angles slightly aciculate; postscutellum blackish sericeous, dull; median segment dorsum dull black, transversely aciculate, with a shallow, median depression and numerous short, black hairs; with no pronounced suture or other mark between the stigma and fovea, which latter is circular in outline; from the fovea

to the petiole is an impressed line in some cases; posterior end thickly, rather finely punctured and abundantly clothed with long hairs; sides of the median segment and metapleura obliquely aciculate, the aciculations coarsest on the median segment next to the metapleura; covered with quite long hairs; mesopleura also obliquely aciculate, except the portion above the anterior and middle coxæ, where it is less pronounced (the amount and strength of the aciculations vary greatly in different specimens); mesosternum with a median impressed line; aciculate between and just in front of the coxæ, with numerous rather coarse punctures and short hairs; petiole shorter than the hind coxæ, straight, with numerous fine punctures and short hairs; an impressed line runs forward from above the posterior coxa nearly horizontally and below the stigma.

*Abdomen*.—Stout, high, sharply pointed behind, rising nearly vertically from the petiole; above, stigma of the first segment in the middle or nearly so; surface smooth, slightly glistening, with a few rather fine punctures, and on the last three plates with a few hairs, longest on the last one; fourth and fifth plates very slightly emarginate behind; last plate rounded acuminate behind, covered with very closely set, minute punctures; beneath somewhat sericeous, with scattered punctures and short hairs; fourth and fifth plates somewhat emarginate behind, the latter quite strongly so; last plate conical, very convex, and with a number of long hairs.

*Wings*.—Fuliginous, lighter on the margin in some cases; fore wing; second cubital cell quite broad; third cubital extending almost as far as the end of the radial cell; second transverse cubital and second recurrent veins sometimes though not usually interstitial; hind wing; transverse median vein slightly arched, making about a right angle with the median vein; discoidal vein not interstitial; cubital vein usually (always?) obsolete beyond the transverse cubital; tegulæ black, tinged with ferruginous behind, sericeous, rather glistening.

*Legs*.—Coxæ rather short, stout, black, with traces of whitish sericeous on the two hinder pairs in some lights; with numerous coarse punctures and a few hairs, stouter toward the outer end of the segment; trochanters black, the hinder pairs closely, minutely, and also coarsely punctured; anterior pair quite closely, coarsely punctured; all bearing a few rather coarse hairs; femora stout, longer than their tibiæ except the hinder pair; front pair smooth, glistening, with scattered punctures and hairs which are longest in a row along an impressed line on the inner face; the other femora sericeous, with scattered punctures and short hairs; fore tibiæ glistening, with numerous coarse spines and long hairs, the latter chiefly on the inner and hinder faces; middle and hind tibiæ sericeous and coarsely spined; hinder face of the hind tibiæ densely brown sericeous; hind tibial spine with coarse, blunt, spaced teeth on its outer half; fore tarsi

somewhat sericeous above; fore metatarsus with seven long, slender comb teeth externally; there is a faint ferruginous tinge to the fore tarsi, particularly to the last segment and claws, which bear five teeth; the other tarsi are somewhat more sericeous. (Plate VI, fig. 6.)

*Male.*—Differs as follows: Clypeus rather broadly emarginate anteriorly, its notch and depression usually less pronounced; eyes convergent somewhat, toward the clypeus; mandibles two toothed, the posterior tooth not nearly as long as in the female, and the whole mandible quite slender; cheeks at their widest place less than half the width of the eye; relative length of filament segments  $\frac{1}{10}$ ,  $\frac{2}{11}$ ,  $\frac{3}{15}$ ,  $\frac{4}{17}$ ,  $\frac{5}{18}$ ; first two filament segments quite short; very delicate transverse aciculations present near the middle of the mesonotum; petiole slightly longer than the hind coxæ; abdomen slightly grayish sericeous above in some lights; fourth and fifth ventral abdominal plates velvety brownish black; the following plates without an excavated hinder margin; terminal plate conical, with a rounded hinder margin.

In some cases the pubescence on the clypeus and frons is almost golden instead of silvery; the vertex and cheeks are whitish sericeous; the base of the femora may be slightly ferruginous and the front of the abdomen may have a faint ferruginous tinge; eight teeth in the metatarsal comb have been observed, and the whole body, particularly in southern specimens, may have a strong brownish tinge.

*Length.*—Female, 15–22 mm.; male, 11–19 mm.

*Chlorion (Priononyx) atratum* appears to be our most generally distributed species of this subfamily in North America except *Chlorion (Proterospheer) ichneumonæum*. I have studied nearly four hundred specimens, taken in Maine, New Hampshire, Massachusetts, New York, Ohio, Michigan, Minnesota, Canada (exact locality?), and Montana, but it does not seem to occur in the Northwest Rocky Mountain region. South of these States it seems to be everywhere present to the southern limits of the United States. I have seen specimens from Alabama, Texas, New Mexico, Arizona, and southern California, but none from Mexico or the West Indies. It is probably found in northern Mexico but is not listed in the *Biologia Centrali-Americana* as having been taken there. It provisions its burrows with grasshoppers (locusts).

Harris's "*Sphex labrosa*" is a female of this species, numbered 123, and in his record book Harris says: "123. *Amophila? labrosus* S. Mss. (Allied to *Sphex* Penselv. L. & D Geer but not half as large as is figured by De Geer.) Is it *Ammophila*? I think it is. Milton July 15, 1826." Consequently Smith was correct as to the identity of *labrosa* with *atratum*.

A prolonged study of the type specimen of *Priononyx brunnipes* Cresson gives no structural characters not present in *atratum*. The distinguishing feature seems to be the decided brownish color which



is rendered more noticeable by the fact that the contents of the type have been removed by museum pests. In the specimens of *atratum* studied, all shades of color from a jet black to the brown of *brunnipes* occur, and I must therefore regard the latter as a color subspecies, most abundant in the southern States though one specimen from Montana is also of this shade.

This insect is well illustrated in Howard's Insect Book, Plate V, fig. 20.

CHLORION (PRIONONYX) THOMÆ (Fabricius).

*Sphex thomæ* FABRICIUS, Syst. Ent., 1775, p. 346.

? *Pepsis crucis* FABRICIUS, Syst. Piez., 1804, p. 209.

*Pepsis thomæ* FABRICIUS, Syst. Piez., 1804, p. 209.

*Priononyx thomæ* DAHLBOM, Hym. Eur., I, 1843, p. 28.

*Priononyx thomæ* DAHLBOM, Hym. Eur., I, 1845, p. 439.

*Priononyx thomæ* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 265.

*Enodia pubidorsum* A. COSTA, Ann. Mus. Zool. Napoli, I, 1862, p. 69.

*Priononyx thomæ* SAUSSURE, Reise d. Novara, Hym., 1867, p. 43 (in part).

*Priononyx thomæ* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 213.

*Sphex thomæ* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 36, pl. III, figs. 12 and 12a.

*Sphex (Harpactopus) thomæ* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 358.

*Sphex (Priononyx) thomæ* FOX, Proc. Acad. Nat. Sci. Phila., 1897, p. 378.

*Sphex thomæ* DUCKE, Zeits. f. Syst. Hym. u. Dipt., I, 1901, p. 241.

Black, to and including the petiole; abdomen more or less ferruginous; pubescence silvery white to yellowish white; wings quite hyaline, faintly fuliginous.

*Female*.—Head large, quadrangular when viewed from above; front slightly excavated between the eyes; clypeus and frons well covered to about the level of the ocelli with yellowish-white pubescence, least so in the middle; clypeus broad, with a marked median notch, the surface around which is depressed; surface of the clypeus with a few coarse, and many fine punctures; this plate and the lower part of the frons with many long, coarse, white hairs, becoming smaller and shorter above; frontal suture present but not strongly developed; continued faintly between the lateral ocelli; an oblique suture is present on each side of the ocelli; distance between the lateral ocelli about equal to their distance from the eyes; surface around the ocelli and on the vertex whitish sericeous, continued over the cheeks; these are quite full but not as broad as the width of the eye; narrowing quickly below; with many long, white hairs below and a few smaller ones above and on the occiput; eyes parallel in front; antennæ black, grayish sericeous on the filament; scape whitish sericeous over a dull, faint ferruginous tinge; with a few short hairs on its tip inside; relative lengths of filament segments  $\frac{1}{2}$ ,  $\frac{2}{1}$ ,  $\frac{3}{1}$ ,  $\frac{4}{1}$ ,  $\frac{5}{3}$ ; mandibles black, with a dull ferruginous cross band near the base of the teeth; with three teeth, the middle one smallest; mandible long, reaching about to the



base of its mate; with an aciculated groove on its front face leading about to the middle tooth and one beneath, besides a few scattered aciculations near the base; behind is a row of long, brownish hairs.

*Thorax.* —Collar rather small, its dorsal edge lower than the highest part of the mesonotum; neck above with a few transverse striations in front, and short, fine, white hairs; its hinder part near the collar smooth, glistening; the angle between the neck and collar nearly a right angle; base of the anterior face near the middle bare, glistening; with one or two short, transverse striae; the rest of this face and the dorsal edge quite densely white pubescent; dorsal edge evenly rounded from front to rear and from side to side, with no median depression, somewhat appressed against the mesonotum; sides of the collar faintly whitish sericeous, obliquely striated near the base of the prothoracic lobe; basal part of the prothoracic lobe very minutely punctured, its hinder half silvery white pubescent and with numerous very fine, long, white hairs; a smooth round hump is present on the collar near the upper part of the base of the prothoracic lobe; prosternum faintly sericeous at the sides, with numerous coarse punctures and long, fine, dirty white to brownish hairs beneath; mesonotum bent strongly downward in front, quite densely black sericeous, with an evident median groove extending about halfway back on the plate; lateral and hinder margins of the plate somewhat reflexed; a silvery white pubescent band extends along each side of the plate from in front of the tegulae backward to its posterior corners and perhaps a little inward on its posterior margin; area inside these bands minutely, closely punctured; scutellum somewhat higher than the adjacent part of the mesonotum, with a slight median depression, somewhat sparsely silvery white pubescent, its sides behind, slightly, obliquely aciculate; postscutellum silvery white pubescent in the middle, its sides blackish sericeous; median segment dull black on the dorsum, showing faint traces of transverse aciculation and rows of fine punctures, sparsely clothed with whitish hairs of medium length; angle between the dorsum and posterior end of the median segment obtuse, though quite sharp; fovea a circular depression a little below the angle; posterior surface slightly, not closely aciculate, bearing longer whitish hairs than those on the dorsum; from the stigmatal region laterally the rugosity is greater and the lines above run almost horizontally, but below they extend more obliquely forward and downward, crossing an impressed line which runs forward from the hind coxae onto the metapleura, being quite coarse where they cross this line; sides of the median segment and metapleura sparsely covered with whitish hairs; metapleura obliquely rugose, most finely so near the base of the hind wings, with a small, silvery whitish spot of pubescence often, just above the hind coxae; mesopleura coarsely, obliquely rugose, finest behind and above the prothoracic lobe; with scattered, coarse punctures along the

grooves; sparsely clothed with short, whitish hairs; mesosternum coarsely, sparsely punctured, glistening, and with a few, short, transverse striae between the mesocoxae; petiole straight, brownish black, finely, not closely punctured, longer than the posterior coxae and bearing short, whitish hairs.

*Abdomen*.—Ferruginous, sometimes shaded with darker; pointed behind, elongate, less so anteriorly but not rounded, rising quite high above the petiole but not at right angles with it; above, rather glistening, with traces of whitish sericeous at the side; stigma of the first segment behind the middle; with a few scattered punctures, most abundant on the last two plates where there are also a few whitish hairs; margin of last plate rounded behind; beneath, similar to above, the hinder margins of the fourth and fifth plates slightly emarginate, however; terminal plate conical, with a narrow, rounded tip.

*Wings*.—Almost hyaline, the front pair faintly fuliginous; the larger veins dark, the smaller ones light brown: fore wing; third cubital cell quite long, extending about as far out toward the wing margin as the outer end of the radial cell; first and second transverse cubital veins running about parallel: hind wing; transverse median vein straight or almost so, making a right angle or slightly less with the medial vein; discoidal vein not interstitial; cubital vein not developed beyond the transverse cubital which joins the radial almost at a right angle; tegulae dull brownish, lighter at the edges, somewhat whitish pubescent anteriorly.

*Legs*.—Black, but with a brownish ferruginous tinge, somewhat glistening, generally more or less whitish sericeous; front and hind pair of coxae so much so as to be almost pubescent; fore coxae with coarse, scattered punctures and rather fine hairs, the punctures absent from the other coxae; fore trochanters with a very few punctures and hairs, middle pair with fewer, hind pair with almost none; fore femora with a slight groove beneath, along which is a row of short, brownish hairs; fore tibiae short, rather stout, with numerous spines; fore tarsi strongly white-sericeous above; the fore metatarsus with seven (sometimes six) long comb teeth alternating with very short spines; claws ferruginous, with five teeth; middle femora with a very few fine punctures and short hairs; middle tibiae minutely punctured, with numerous spines; hind femora with a few scattered, minute punctures and fine hairs beneath; posterior surface of hind tibiae densely brownish sericeous; the tibial spine with coarse, spaced blunt teeth on its outer half.

*Male*.—Differs as follows: Body generally more hairy; with coarser punctures on the sides of the thorax; abdomen quite compressed laterally, somewhat crescentic in outline when viewed from the side; first and second segments of the filament taken together not equal in length to the third; fourth and fifth ventral abdominal plates silky

sericeous; abdomen generally with more dark or black on it than in the female; pubescence generally somewhat more developed.

*Length*.—Females, 12–21 mm.; males, 8–14 mm.

This species is essentially tropical and subtropical in distribution. First described from St. Thomas, I have seen specimens from Cordoba, Argentina; and from Brazil, Cuba, Jamaica, Mexico, Texas, New Mexico, California, Utah, Nevada, Colorado, Arizona, and Montana. Specimens from Florida; Camden County, New Jersey; Raleigh, North Carolina, and Georgia, which I have also studied, seem to be intermediate between this species and the next (*C. bifoventatum*), agreeing in some characters with the one, and in others with the other, and it has finally seemed necessary to name them in accordance with the preponderance of these characters.

Characters separating *Chlorion thomæ* from *Chlorion bifoventatum*.

For this purpose Kohl gives numerous distinguishing features, particularly relating to comparative measurements of different parts of the body. Tests of these on several hundred specimens have not given satisfactory results as a whole, so many examples agreeing in part with one set and in part with the other. The following characters seem to the writer to be those most useful in separating the species, but only when taken together. The female *C. thomæ* has the sculpturing of the thorax everywhere developed; the ridges from the base of the hind wing to the median segment stigma run nearly horizontal; pubescence is present on the prothoracic lobe and above the middle and hind coxæ and is generally quite strongly developed; the wings are more hyaline and the average size of the individuals is larger. The female *C. bifoventatum* may have the sculpturing of the thorax everywhere developed, but there is a strong tendency for it to be replaced, particularly on the dorsum of the median segment and on the sides of the thorax by a dull, lusterless black, which shows no markings of any kind. The ridges between the base of the hind wing and the stigma of the median segment run more obliquely downward and forward; traces of pubescence may be present where they are in the other species, but they are merely traces; the wings are somewhat more fuliginous everywhere, and the average size is less.

The males are more readily distinguished. In *C. thomæ* the length of the first two segments of the filament taken together is less than that of the third, and the posterior margins of the sixth and seventh ventral abdominal plates, though sometimes slightly emarginate, are never excised, though in one or two cases I have seen specimens in which slight elevations at the sides with a depression in the middle gave a very deceptive appearance to these segments. In *C. bifoventatum* the length of the first two segments of the filament taken together exceeds the length of the third, and the posterior margins of the sixth



and seventh ventral abdominal plates each have a broad, quite deep excavation (fig. 11).

The extreme difficulty in separating these species, particularly from North Carolina, Florida, and elsewhere in that region, has frequently raised the question during their study whether they are not really the same, with dimorphic males.

None of the specimens I have studied agree with *C. exisus* Kohl, though several were taken in the same locality as his specimens of this species. He separates *exisus* from *bifoveolatus* by comparative measurements of different parts of the body, and in some cases I have found individuals which in some of these measurements agreed with those given for *exisus*, but in the others agreed with those given for *bifoveolatus*. In consequence I must place *C. exisus* Kohl as one of the species unknown to me, though with some question as to its being a valid species.

Illustrations of *Chlorion thomæ* are given in the Insect Book, Plate VII, fig. 6, and Plate XI, fig. 7, the latter figure being wrongly named.

CHLORION (PRIONONYX) BIFOVEOLATUM (Taschenberg).

*Priononyx thomæ* var. SAUSSURE, Reise. d. Novara, Hym., 1867, p. 43.

*Priononyx bifoveolata* TASCHENBERG, Zeits. f. d. ges. Naturw., XXXIV, 1869, p. 408.

*Priononyx thomæ* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 384.

*Priononyx canadensis* PROVANCHER, Addit. faun. Ent. Can., 1889, p. 258.

*Sphex* (*Harpactopus*) *bifoveolatus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 360.

*Sphex* (*Priononyx*) *bifoveolatus* Fox, Proc. Acad. Nat. Sci. Phila., 1897, p. 378.

Black except the abdomen, which is varied with ferruginous; well clothed with gray hairs; wings quite hyaline to somewhat fuliginous.

*Female*.—Head large, broader than the distance between the outer edges of the tegulae, slightly quadrangular, the cheeks being quite full above; frons slightly excavated between the eyes; clypeus and frons pale yellowish pubescent to the ocelli, least so in the middle; clypeus broad, square below, with a deep central depression of the anterior edge, which is slightly reflexed; its surface with scattered punctures and bearing quite long, pale yellow hairs, true also of the frons; ocelli surrounded by sutures inclosing them in a triangular area; frontal suture evident; lateral ocelli about equidistant from each other and from the eyes; vertex sparsely, minutely punctured, whitish or grayish sericeous in some lights, with numerous medium long, gray hairs; cheeks quite broad above, narrowing rapidly below, gray sericeous, with scattered punctures more abundant and larger below, with scattered gray hairs above, longer and more abundant below; inner edges of eyes very slightly nearer at the clypeus than at the vertex, but their lower portion parallel; antennae black, scape slightly grayish sericeous and with a few gray hairs; filament slightly sericeous, their



relative segment lengths  $\frac{1}{18}$ ,  $\frac{2}{13}$ ,  $\frac{3}{12}$ ,  $\frac{4}{12}$ ,  $\frac{5}{12}$ ; mandibles long, each reaching to the base of the other; black with a ferruginous tinge near the base of the teeth; 3-toothed, the anterior tooth the smallest.

*Thorax*.—Black, with traces of pale yellow to silvery white pubescence on the dorsal edge of the collar, sides of the mesonotum, middle of the scutellum and postscutellum, and above and somewhat in front of the middle and hind coxæ and on the posterior end of the median segment; quite long gray hairs generally distributed; neck black sericeous, as is also the anterior face of the collar except at the junction with the neck, where there is a bare space showing faint transverse rugosities; sides of collar less sericeous than the front; prothoracic lobe with a faint trace of whitish pubescence; mesonotum black sericeous except where pubescent, its sides and hinder end slightly reflexed, with a perceptible median groove on the anterior half of the plate; scutellum black sericeous except for a spot of silvery whitish pubescence on its middle which is higher than the mesonotum; with no perceptible median groove; postscutellum black sericeous, with a faint pubescent spot in the middle (these pubescent spots are frequently absent); median segment dull, velvety black sericeous above, with quite numerous long, white or gray hairs; a slight broad hollow is present in front of the fovea, which is small and circular in outline; posterior end forming quite an angle with the dorsum, though less than a right angle; its surface often with traces of silvery white pubescence and with many long gray hairs; sides of the median segment clothed with similar hairs; a groove runs nearly horizontally forward from the posterior coxæ; above this on the sides of the median segment are fine ridges running downward and somewhat forward and in part continued across the groove onto the metapleura; mesopleura coarsely vertically rugose below in front, these rugosities disappearing on the hinder part, but with scattered punctures on both parts; a trace of silvery white pubescence just above the mesocoxæ; metapleura dull black, sericeous, sometimes with a trace of a very short, silvery white pubescent band just beneath the posterior end of the groove, between the metapleura and the median segment; meso- and metapleura with numerous long gray hairs; mesosternum with the rugosity from the mesopleura continued onto it for a short distance; coarsely punctured and with long gray hairs; petiole black, straight, with numerous long white or gray hairs, most abundant near its base; noticeably longer than the second hind tarsal segment.

*Abdomen*.—Dull ferruginous with darker shading, particularly on the hinder dorsal plates; rising high but not sharply above the petiole; ovate; pointed rather more behind than in front; above, glistening, with traces of white sericeous at some angles; hind edges of the dorsal plates paler than the remainder; terminal plate rounded acuminate behind, quite compressed laterally; bearing a few scattered punctures;

beneath; glistening, with irregularly located darker areas; posterior margin of the fourth plate slightly, broadly emarginate; terminal plate conical, with a few scattered, quite long, dark gray or brownish hairs; first ventral plate (behind its petiolar part) ferruginous.

*Wings.*—Nearly hyaline, though varying much in this regard, the outer margins more fuliginous than the rest; basal half of the fore wing with a faint yellowish tinge; fore wing: second cubital cell much higher than wide; first recurrent vein interstitial or nearly, with the first transverse cubital; second recurrent vein joining the third cubital cell a little beyond the second transverse cubital; hind wing: transverse median vein almost straight, forming nearly a right angle with both the median and anal veins; discoidal vein not nearly interstitial; cubital vein absent beyond the transverse cubital; radial extending only a short distance beyond the latter; tegulae dull brown, almost black, the anterior part slightly whitish sericeous.

*Legs.*—Black, strongly whitish sericeous; coxae coarsely punctured, more sparsely on the hinder legs; with scattered, long, whitish hairs; trochanters similar, but more sparsely punctured; femora still more sparsely punctured or not at all; fore femora with a row of medium long hairs on the inner face; tibiae not punctured; fore tibiae with a row of hairs on the inner face; hinder face of hind tibiae strongly brownish sericeous; anterior metatarsus with six (sometimes seven) long, stout comb teeth alternating with very short ones; claws with five black teeth, the inner one small; tips of the claws dull, dark ferruginous.

*Male.*—Differs as follows: Lateral ocelli very slightly nearer each other than to the eyes; relative length of filament segments  $\frac{1}{4}$ ,  $\frac{2}{7}$ ,  $\frac{3}{10}$ ,  $\frac{4}{10}$ ,  $\frac{5}{10}$ ; mandibles black, two toothed, not reaching across to the base of the other one of the pair; sides of the thorax rather more coarsely marked and more hairy than in the female; form of the abdomen bluntly elliptical or oval, the hinder portion bent slightly under; the surface above, whitish sericeous, particularly noticeable on the darker portions; first dorsal plate not rising very abruptly from the petiole; fourth and fifth ventral abdominal plates silky black, sericeous, as is the sixth, the hinder margin of which and of the seventh are broadly, deeply excised, the margins bearing fine, short hairs.

*Length.*—Females, 11–19 mm.; males, 9–15 mm.

This species was originally described from New Friburg, but is widely distributed in North America. The most northern localities from which I have seen specimens are Truro, Massachusetts; Milford, Connecticut; Long Island, New York, and from Illinois, Wisconsin, Montana, Idaho, and Washington. From these States it is quite generally distributed southward, and I have seen examples from Florida, Texas, New Mexico, Arizona, and California. It has also been reported from Mexico, but I find no record of its capture in the West Indies,

though the literature of this species and of *C. thomæ* is so mixed that references to the latter may in some cases belong here.

The first few dorsal abdominal plates are frequently noticeably silvery pubescent, and this has in some cases been supposed to be a specific distinction, but as this is also quite pronounced in some specimens of *C. thomæ* it can not be relied upon for this purpose.

A good figure of one of the less pubescent individuals of *♂ bifoveolatum* is given as fig. 23, Plate XI, of the Insect Book.

**Subgenus ISODONTIA Patton (genus).**

*Isodontia* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 380.

*Isodontia* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 114.

*Isodontia* KOHL, Ann. natur. Hofmus. Wien, XI, 1896, p. 319.

*Type: Chlorion (Isodontia) harrisi.* (Designated by Patton.)

Claws with two blunt teeth near the base of their inner border. Median segment without a stigmatal groove, rarely with a faint trace of one near the hinder end. Stigma of the first dorsal abdominal plate in front of the middle. Tarsal comb of the female absent. Comb teeth of the hind tibial spine not tooth-like but forming a row of closely set hairs. Inner borders of the eyes parallel or converging downward, the latter especially in the males. Second cubital cell of the fore wing rhombic, rhomboidal or approaching a rectangular form, at least as broad on the cubital vein as it is high. Distance between the second and third transverse cubital veins on the radial cell greater than that between the second transverse cubital and second recurrent veins on the cubital vein. Collar not strongly developed, not as high as the mesonotum. Mesonotum punctured. Dorsum of median segment dull, without markings, or slightly punctured, rarely with transverse striations. Petiole long, generally bent upward. Mandible with two or three teeth; not reaching the base of the other when closed. Abdomen rather flattened dorso-ventrally; in the male with rows of rather coarse, backwardly pointing hairs beneath. Body as a whole usually slender. (Plate IX, fig. 17; Plate X, fig. 26.)

This subgenus is easily separated from those already considered by the strikingly different form of the second cubital cell, in which it comes nearest to *Proterospheæ*, and by the length of the petiole. From *Proterospheæ* it is distinguished by the absence of a stigmatal groove (except in one case) as well as by other and less noticeable characters. In both it and *Proterospheæ* the eyes seem to be carried inward toward the center of the head so that they are nearer each other there than a short distance below, though they may converge toward the clypeus till nearer each other than at the top.



## CHLORION (ISODONTIA) EXORNATUM (H. Fernald).

*Isodontia exornata* H. FERNALD, Can. Ent., XXXV, 1903, p. 270.

*Cotypes*.—Five male and two female specimens now in the collections of the U. S. National Museum in Washington (Type, Cat. No. 6931, U.S.N.M.), American Entomological Society in Philadelphia, Massachusetts Agricultural College, Amherst, Massachusetts, and Dr. W. H. Ashmead, Washington City.

Body rather slender, black, parts of the antennæ and legs and the petiole yellow; wings deep fuliginous, with a slight violet reflection.

*Female*.—Head; clypeus somewhat arched laterally, with a faint median carina most pronounced posteriorly, sometimes not perceptible; anterior margin quite broad, slightly reflexed, with two short, blunt teeth close together at the middle; surface sparsely covered with yellow hairs; clypeus and frons to the level of the insertion of the antennæ golden pubescent; frons, vertex, and cheeks with scattered punctures and long yellowish hairs; cheeks with a narrow, yellow, pubescent band just behind the eye; eyes slightly converging toward the clypeus; antennæ, first six to eight segments yellow ferruginous, the remainder black; scape with a few yellowish hairs; first segment of the filament longest; mandibles two-toothed, black at the base and tip; elsewhere ferruginous.

*Thorax*.—Collar faintly punctured, clothed with scattered yellow hairs; its dorsal edge and the posterior margin of the prothoracic lobe golden pubescent; mesonotum black with yellow hairs, rather coarsely punctured and with a short, median groove extending about one-third the length of the plate from its anterior edge; scutellum punctured, the punctures rather more scattered than on the mesonotum; on each side just internal to the attachment of the hind wing is a golden pubescent spot; postscutellum covered with golden pubescence; median segment coarsely punctured; a golden pubescent band on each side passes from a point just lateral to the edge of the pubescence on the postscutellum downward and backward below the stigma to the posterior coxa; posterior end of the median segment between the fovea which is hyphen-like and the petiole, with a somewhat quadrangular, golden pubescent spot; the end and sides of the median segment quite thickly clothed with yellowish-brown hairs; mesopleuron with a somewhat triangular, golden pubescent spot just behind the prothoracic lobe, and sometimes with a smaller one between this and the base of the fore wing; mesopleuron and the upper part of the metapleuron rather coarsely punctured and sparsely clothed with long yellow hairs; petiole long, slightly curved, ferruginous yellow, somewhat darker at the base beneath, with numerous yellowish hairs; its posterior portion yellowish pubescent.



*Abdomen*.—Base of the first dorsal plate yellowish, the remainder of the dorsal surface black, except that in some cases the hinder margins of the plates are pale; surface faintly pale sericeous and with a few scattering hairs on the posterior plates; beneath, minutely punctured, pale sericeous; terminal plate conical, with a rounded hinder margin.

*Wings*.—Deep fuliginous, with a slight violet reflection; discoidal vein of the hind wing interstitial with the median and transverse median veins; tegulae smooth, pale yellow.

*Legs*.—Coxae, trochanters, and proximal part of the femora black, hairy, the remainder ferruginous; the black portions sometimes yellowish sericeous, almost pubescent; spines dark ferruginous; tips of the claws nearly black; posterior tibiae strongly yellow sericeous behind.

*Male*.—Differs from the female in no important features not true as sexual distinctions throughout this subgenus. The more flattened abdomen and the rows of backwardly pointing hairs on the posterior margins of the ventral abdominal plates, besides the presence of thirteen segments in the antennae instead of twelve as in the females are ready characters for determining the sex.

*Length*.—Females, 16–20 mm.; males, 16–19 mm.

I have seen specimens of this beautiful and apparently rare species from Indian River and Biscayne Bay, Florida; from North Carolina and Georgia; and from Willis, Texas, captured there June 11.

At the time the original description was published there was no species of the subgenus known in the United States which closely resembled it. Larger collections, however, have revealed the fact that that most variable species, *Chlorion (Isodontia) costipennis* Spinola has been taken in Mexico, and that it is sometimes difficult to separate the two by any one character though taken all in all the two look quite different. As *C. costipennis* is an exceedingly variable form it is possible that *C. crornatum* may at some time prove to be but a subspecies, though I am at present far from believing that such is the case.

When specimens of *C. crornatum* were first studied in the course of this work some of those in the collection of the American Entomological Society were found to bear the label "*crornata*," a manuscript name, probably given by W. J. Fox. As it seemed not improbable that this name might have been sent out on specimens it appeared best to retain it for this insect to avoid any confusion which might otherwise arise.

#### CHLORION (ISODONTIA) COSTIPENNIS (Spinola).

*Sphex costipennis* SPINOLA, Mem. Acad. Torino, XIII, 1851, p. 54.

*Sphex chrysobapta* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 257.

*Sphex petiolata* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 259.

*Sphex costipennis* SAUSSURE, Reise d. Novara, Hym., 1867, p. 39.

*Isodontia costipennis* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 381.

*Sphex costipennis* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 35, pl. III, fig. 10.

*Sphex (Isodontia) costipennis* KOHL, Ann. Natur. Hofmus. Wien, V, 1890, p. 382.

*Sphex (Isodontia) costipennis* FOX, Proc. Acad. Nat. Sci. Phila., 1897, p. 375.

*Sphex (Isodontia) costipennis* DUCKE, Zeits. f. Syst. Hym. u. Dipt., I, 1901, p. 241.

Black or black and ferruginous, the distribution of these colors varying greatly; with golden pubescence and hairs, varying much in abundance and location; legs usually in part ferruginous yellow; petiole very long; wings quite hyaline, sometimes partly fuliginous, generally distinctly tinged with yellow.

*Female*.—Head broad, not noticeably hollowed in front between the eyes; clypeus broad, extending well downward at the sides, its anterior edge reflexed, nearly straight, with a pair of short, tooth-like projections at the center more or less developed, with a median carina on its posterior half; clypeus and frons to the ocelli usually thickly pubescent and bearing long yellow hairs; vertex and cheeks with many long hairs; cheeks rather more than half the width of the eye, with a narrow band of pubescence just behind the latter; narrowing rather quickly below; scape more or less sericeous and bearing short hairs; first segment of the filament the longest; eyes slightly converging downward; mandibles two-toothed, glistening, generally ferruginous except the base and the tips of the teeth.

*Thorax*.—Neck very short; collar narrow from front to rear, rising sharply at right angles to the dorsal surface of the neck; the dorsal edge of the collar evenly rounded from side to side, the sides of the collar forming a sharp angle with this edge, which is pubescent; a marked depressed line runs back from the middle (in height) of the anterior face of the collar to near the middle of the base of the prothoracic lobe which is pubescent; mesonotum sharply bent downward in front and almost vertical at the sides in front of the tegulae, with a median groove or impressed doubled line extending back from the anterior margin about one-third of the length of the plate; surface of the plate quite closely punctured and bearing numerous hairs; scutellum rather broad from front to rear, evenly rounded, with a pubescent spot on each hinder corner; post-scutellum pubescent, apparently with a faint median impression; dorsum of the median segment closely, rather coarsely punctured, sometimes pubescent; fovea small, slightly crescentic rather than hyphen-like; posterior end from the fovea to the petiole with a quadrangular, pubescent spot; sides of the median segment closely punctured and with fine, nearly vertical aciculations; a pubescent band runs from the hind coxae forward and upward below the stigma to the front corner of the dorsum; meso- and metapleura coarsely, closely punctured, the latter the least of the two; petiole

long, slightly curved, with fine punctures and hairs; somewhat sericeous, almost pubescent on its posterior part.

*Abdomen*.—Rather ovoid, more pointed in front than behind; flattened beneath, very coarsely grayish sericeous, both above and below; posterior margins of the third, fourth, and fifth ventral plates emarginate, this increasing posteriorly; terminal plates above and below with scattered hairs, together quite conical in form.

*Wings*.—Generally quite hyaline, sometimes more or less fuliginous on the anterior and outer margins; generally with a strong yellow tinge.

*Legs*.—Black, ferruginous, or both colors, the coxæ, trochanters, and basal half of the femora being black, as are frequently the outer segments of the tarsi also; strongly sericeous, often pubescent in spots on the coxæ and femora.

*Male*.—Differs from the female apparently, only in being more strongly punctured, more generally pubescent, and in the usual sexual characters.

*Length*.—Females, 18–23 mm.; males, 13–22 mm.

*Chlorion (Isodontia) costipennis* is a well known South and Central American insect, having been captured in Brazil, Surinam, Guiana, Guatemala, Panama, and Costa Rica. I have found no published record of its capture in localities farther north, but have seen specimens taken in Mexico (locality not given) and in Santo Domingo, which bring it farther within the faunal limits of this paper.

It is an exceedingly variable species as regards coloration, the amount of pubescence, etc., which in some cases renders it difficult of determination.

#### CHLORION (ISODONTIA) AZTECUM (Saussure).

*Sphex aztecus* SAUSSURE, Reise d. Novara, Hym., 1867, p. 38.

*Isodontia azteca* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 381.

*Sphex azteca* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 35, pl. III, figs. 9, 9a.

*Sphex robusta* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 36, pl. III, fig. 11.

*Sphex (Isodontia) macrocephalus* FOX, Ent. News, I, 1890, p. 137.

*Sphex (Isodontia) aztecus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 385.

*Isodontia azteca* PATTON, Ent. News, IV, 1893, p. 302.

*Isodontia azteca* PATTON, Proc. Ent. Soc. Wash., III, 1894, p. 46.

*Sphex (Isodontia) macrocephalus* KOHL, Ann. natur. Hofmus. Wien, X, 1895, p. 50.

*Isodontia azteca* H. FERNALD, Can. Ent., XXXV, 1903, p. 269.

*Isodontia macrocephala* H. FERNALD, Can. Ent., XXXV, 1903, p. 269.

Type of *macrocephalus* FOX, one female, slightly imperfect, in the collection of the U. S. National Museum (Type Cat. No. 9906, U.S.N.M.), from which the following description has been prepared:

*Female*.—Large, robust, black, without pubescence. Head large, rather quadrangular when viewed from above; clypeus arched laterally, coarsely punctured, covered with long, coarse, black hairs; with a median carina on its posterior portion; its anterior margin slightly

reflexed, a little rounded, with a pair of short, blunt projections, close together at the middle; frons rather more sparsely punctured than the clypeus, bearing long, black hairs; vertex and cheeks rather coarsely, sparsely punctured; near the upper, inner angle of the eye, on a line drawn through the median and a lateral ocellus is a large puncture with a macrochaeta; cheeks nearly the width of the eye, densely clothed below with long, black hairs; inner margins of the eyes parallel or nearly so; antennae black, the scape with long, black hairs; first segment of the filament nearly one-third longer than the second which is slightly longer than the third; mandibles two toothed, the lateral tooth blunt and with a groove running back toward its base from a central notch at its edge; a nearly obsolete ferruginous band crosses the mandible near the base of the teeth.

*Thorax*.—Collar sparsely punctured; prothoracic lobe fringed behind with short, pale hairs; mesonotum with a median impressed band anteriorly, extending about one-third the length of the plate; the remainder rather more closely punctured than the collar and covered with erect, black and pale hairs; a trace of a parapsidal groove is present; scutellum and postscutellum smoothly rounded, without a median depression, sparsely punctured; median segment closely punctured, clothed particularly at the sides and behind with long, black, and pale hairs; in some lights a faint trace of an impressed line from the hind coxa to the stigma may be seen; sides of the thorax quite closely and evenly punctured, bearing long, black, and a few pale hairs; petiole less than twice the length of the posterior coxa, slightly curved, bearing minute punctures less abundant toward the abdomen, thinly clothed with long, pale hairs.

*Abdomen*.—Black, glistening, with a few scattered, black hairs toward the posterior end; beneath glistening, with a few scattered punctures and black hairs, mainly on the terminal plate.

*Wings*.—Dark fuliginous with a blue or violet reflection; radial cell rather bluntly rounded at the tip; discoidal vein of the hind wing interstitial.

*Legs*.—Black, glistening; the femora with scattered punctures and hairs; hind tibiae strongly brownish sericeous behind.

Additional features from other specimens. In some cases there is a trace of silvery pubescence on the sides of the clypeus and the impressed line from the hind coxa to the stigma of the median segment is more evident, being almost a stigmatal groove. In a specimen from Paraguay the tibiae and metatarsi have a slight brown tinge.

*Male*.—Head thickly clothed with long black and gray hairs; clypeus long, strongly arched laterally, its anterior margin slightly rounded and with a faint notch at the center; covered with a sparse, silvery-white pubescence which extends up on the frons to the attachment of the antennae; the surface of the frons closely, quite coarsely



punctured to the level of the ocelli; lateral ocelli nearer each other than to the compound eyes; vertex and cheeks rather less closely punctured than the frons, bearing long, erect hairs; cheeks narrow, less than half the width of the eye; eyes about equidistant at the vertex and clypeus; antennæ black; relative lengths of the filament segments  $\frac{1}{12}$ ,  $\frac{2}{12}$ ,  $\frac{1}{13}$ ,  $\frac{1}{15}$ ,  $\frac{5}{17}$ ,  $\frac{6}{18}$ ,  $\frac{7}{16}$ ; mandibles glistening black, two toothed, neither tooth showing any sign of division into two.

*Thorax*.—Collar very narrow at its dorsal edge, sparingly punctured, with a trace of silvery pubescence at the sides of this edge in some cases; prothoracic lobe fringed behind with fine, whitish hairs; mesonotum with a median impressed, narrow band on its anterior third; the remainder closely punctured; scutellum broad from front to rear, rather flattened, quite evenly but not very closely punctured; post-scutellum narrow, evenly rounded, punctured like the scutellum; dorsum of the median segment very closely, coarsely punctured, quite thickly covered with erect black and gray hairs; fovea somewhat crescentic, shallow, with a faint depression running from its middle toward the petiole; coarsely punctured (possibly with faint elevations instead); sides of the thorax quite evenly but not very closely punctured; an impressed line runs from the hind coxa toward the stigma of the median segment but is very faint and can hardly be called a stigmal groove; a similar line runs more directly forward to the vertical part of the mesopleuron; petiole black, slightly curved, considerably longer than the posterior metatarsus, bearing numerous long, gray hairs.

*Abdomen*.—Black, glistening, with numerous short, erect hairs on the posterior plates; the first plate long, rather acuminate and frequently with a trace of ferruginous just behind the petiole; beneath flattened, the third, fourth, fifth, and sixth plates each with a transverse row of hairs projecting backward; the sixth and more posterior plates more or less broadly emarginate.

*Wings*.—Entirely fuliginous in some cases, the anterior half only in others, with a blue to violet reflection; cubital and subdiscoidal veins of the forewing well developed beyond the ends of the cells; discoidal vein of the hind wing interstitial, the cubital at that point bending sharply forward before resuming its outward direction; the radial and cubital veins of this wing well developed beyond the transverse cubital.

*Legs*.—Black, sometimes with traces of ferruginous in places; glistening; posterior face of the hind tibiæ strongly brownish sericeous; spines black.

*Length*.—Females, 18–22 mm.; males, 13–20 mm.

This species does not appear to be very common, though widely distributed. I have seen specimens from Long Island, New York; Belle Plain, Clementon, Riverton, and Glassboro, New Jersey; Philadel-

phia and Westmoreland counties, Pennsylvania; Washington City; Georgia; Chokoloskee, Florida; and from Dallas, Texas; southern Illinois; Virginia; Nevada and California. Two dates of capture are September 30, 1902, at Belle Plain, New Jersey, and September 26, 1904, at Paris, Texas.

There has been some question as to the identity of *C. macrocephalum* Fox with *C. aztecum* Saussure. The two mandibular teeth of the latter as compared with the teeth of the former would lead to the belief that in *C. macrocephalum* the lateral tooth is the result of the fusion of two placing it in the three-toothed group; the relative length of the first segment of the filament as compared with the seventh or eighth is very different in the two, and though these differences are sexual and normal in *Priononyx* they do not occur as such in *Isodontia*. As Doctor Kohl has seen and studied Saussure's type of *aztecum* I sent authoritative specimens of *macrocephalum* to him for examination and he writes as follows: "Meine *azteca* umfasst die *Is. macrocephala* von Fox, welche dunkelhaarig ist und gleichmässig gebräunte Flügel zeigt, und auch Ihre *Is. macrocephala* var. *cinerea* mit greisen Haaren und Flügeln die an der Vorderhälfte sehr dunkel hinten aber aufgehellte sind." This would seem to conclusively place *macrocephalum* as a synonym of *aztecum*.

CHLORION (ISODONTIA) AZTECUM CINEREUM (H. Fernald).

*Isodontia macrocephala* var. *cinerea* H. FERNALD, Can. Ent., XXXV, 1903, p. 271.

*Types*: Four females, now located one each in the collections of the U. S. National Museum in Washington (Type, Cat. No. 6932, U.S.N.M.), American Entomological Society in Philadelphia, Dr. W. H. Ashmead in Washington City, and the Massachusetts Agricultural College, Amherst, Massachusetts.

This subspecies differs from the typical form in its clothing, which is more abundant and dirty white in color. The hairs cover the thorax thickly, particularly on the dorsum of the median segment. The silvery white pubescence, of which there is generally only a trace, is also more developed here, usually being very noticeable on the clypeus and frons up to the level of the insertion of the antennæ. Generally, too, the wings are less fuliginous and the violet reflection is correspondingly weaker. The size of the individuals averages about the same as in the typical members of the species.

The specimens of this subspecies seen were captured at Columbia, South Carolina; Enterprise and Indian River, Florida; Georgia; and Dallas, Texas.

CHLORION (ISODONTIA) AURIPES, new name.

||*Sphex tibialis* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 339.

*Sphex tibialis* PACKARD, Guide to Study of Ins., 2d ed., 1870, p. 168.

*Sphex tibialis* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 211.

*Isodontia tibialis* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 381.

*Spheg (Isodontia) tibialis* KOHL, Ann. natur. Hofmus. Wien, V, 1890, pp. 122 and 379.

*Isodontia tibialis* ASHMEAD, Psyche, VII, 1894, p. 64.

*Spheg tibialis* PACKARD, Journ. N. Y. Ent. Soc., IV, 1896, p. 158.

*Isodontia tibialis* H. FERNALD, Can. Ent., XXXV, 1903, p. 269.

Body quite large, black; outer segments of the legs ferruginous yellow; wings fuliginous with a violet reflection; pubescence golden to yellow.

*Female*.—Head black, rather quadrangular from above, the cheeks being quite full; clypeus arched laterally, quite long, its anterior corners rounded, the anterior margin slightly excavated from each corner to near the middle, where there is a projecting tooth with a deep notch in the middle separating the two teeth; this margin of the clypeus is bare and somewhat ferruginous in some cases, the rest of the plate being black, yellow pubescent, and covered quite closely with long, brown hairs; frons yellowish pubescent to the insertions of the antennæ, higher at its sides, bearing long, brown hairs; frontal suture evident; lateral ocelli but a short distance behind the median one, the three lying in a curve rather than marking the corners of a triangle; vertex sparsely punctured, bearing long hairs; cheeks broad, half the width of the eye, narrowing sharply below; with a trace of yellow pubescence just behind the middle of the eye; with long hairs, longer, coarser, and more abundant below; inner margins of the eyes slightly convergent toward the clypeus; antennæ black, the outer portion rather brownish or grayish sericeous; scape with numerous short, brown hairs and sometimes slightly sericeous; first segment of the filament the longest; mandibles short, with three teeth of about equal length; the teeth black and the base blackish; the rest of the mandible ferruginous to dull yellow; with faint punctures and scattered hairs.

*Thorax*.—Neck short, broad; collar rising obliquely backward from the neck to a quite sharp dorsal edge which is evenly rounded laterally and is strongly yellowish sericeous, almost pubescent; posterior face vertical, not closely appressed against the mesonotum; prothoracic lobe slightly yellowish pubescent behind; the entire collar sparsely covered with dark brown hairs; mesonotum bent strongly downward in front and at the sides in front of the tegulæ; its surface finely, sparsely punctured and bearing short, brown hairs; with an anterior, median, impressed line and parapsidal lines perceptible; scutellum rather broad from front to rear, flattened above; its sides quite strongly depressed; with punctures and hairs like those of the mesonotum; postscutellum narrow, evenly rounded, with scattered, fine punctures and hairs; dorsum of the median segment rather coarsely, very closely punctured; with a broad, slight median depression posteriorly, and with many brown hairs; angle between the dorsum and the posterior end slight, located just above the fovea which is



a short, transverse, impressed dash; posterior end and sides of the median segment closely, coarsely punctured, with a tendency toward rugosity at the sides, particularly in front of the stigma; thickly covered with many long, brown hairs; the impressed line from the stigma to the postscutellum well developed; that from the stigma to the fovea nearly obsolete; meso- and metapleura more finely, sparsely punctured than the median segment, bearing numerous long, brown hairs; a spot of yellow pubescence is present above the hind coxa; petiole long, black, considerably curved, minutely punctured and bearing long, brown hairs; its hinder portion pale yellowish sericeous.

*Abdomen*.—Black, ovoid, more pointed in front, flattened beneath; first dorsal plate not rising sharply from the petiole but nearly continuing the petiolar line of curvature; upper surface quite smooth and somewhat glistening, pale sericeous, with a few scattered punctures and brown hairs on the hinder plates; beneath similar, but with the punctures and hairs rather more equally distributed on all the plates; posterior margin of the fourth plate slightly, of the fifth considerably emarginate.

*Wings*.—Deep fuliginous; cubital vein of the fore wing only very slightly developed beyond the third transverse cubital; discoidal vein of the hind wing not quite interstitial; tegulae yellowish mottled with brown; somewhat yellowish sericeous.

*Legs*.—Long, the coxae, trochanters and basal portions of the femora black, the remainder pale ferruginous or yellow, the last tarsal segment darker; coxae, trochanters and femora with scattered, fine punctures and hairs; more or less yellow sericeous; spines of the tibiae and tarsi brown or black, as are also the tips of the claws; tarsi yellow sericeous above; hind tibiae strongly yellow sericeous on the posterior face.

*Male*.—Differs as follows: Clypeus more rounded anteriorly, with a slight central notch but no teeth at the sides of it; the margin black; hinder margins of the dorsal abdominal plates pale; the more posterior plates coarsely gray sericeous; usually without pubescence above the hind coxae; tibiae often dark brown instead of ferruginous yellow; otherwise differing only in the sexual characters.

*Length*.—Females, 17–25 mm.; males, 14–22 mm.

This species seems to belong to the Upper and Lower Austral life zones of the United States, the most northern captures known to me being at Nyack, New York; Long Island, New York; Jeannette, Pennsylvania; Cedar Point and Sandusky, Ohio. From these localities south it appears to be fairly common as far as Chokoloskee, Florida, and Dallas, Texas. Whether it extends much farther west I can not judge, as several other specimens are labeled "Tex." without fuller data. It has not been reported from Kansas, nor does it appear in any of the large collections from the west.



Lepeletier's name "tibialis" being preoccupied, and no available synonym existing, it is necessary to propose a new name for this insect and I have selected "*auripes*" for this purpose.

This insect is pictured as figure 17, Plate VII, in the Insect Book.

**CHLORION (ISODONTIA) HARRISI, new name.**

*Sphex apicalis* HARRIS, Cat. An. Mass., 2d ed., 1835, p. 588 (*nomen nudum*).

? *Sphex philadelphia* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 340.

|| *Sphex apicalis* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 262.

*Sphex apicalis* SAUSSURE, Reise d. Novara, Hym., 1867, p. 38.

*Sphex apicalis* var. *mexicana* SAUSSURE, Reise d. Novara, Hym., 1867, p. 38.

*Sphex apicalis* TASCHENBERG, Zeits. f. d. ges. Naturw., XXXIV, 1869, p. 414.

*Isodontia philadelphia* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 380.

*Sphex apicalis* BRUNER, Rept. U. S. Dept. Agr., 1884, 1885, p. 400.

*Sphex apicalis* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 35.

*Sphex (Isodontia) philadelphicus* KOHL, Ann. Natur. Hofmus. Wien, V, 1890, p. 380.

*Isodontia philadelphia*, ASHMEAD, Ins. Life, VII, 1894, p. 241.

*Isodontia apicalis* H. FERNALD, Can. Ent., XXXV, 1903, p. 269.

*Isodontia philadelphicus* JONES, Ent. News, XV, 1904, p. 17, pl. III.

Black with brown and gray hairs; wings more or less fuliginous with violet reflection; pubescence silvery white.

*Female*.—Head quite large, quadrangular from above; clypeus arched laterally, its anterior margin with rounded corners, slightly emarginate and with two teeth in the middle, separated by a rounded, rather shallow notch; surface silvery-white pubescent and quite thickly covered with long, black and brown hairs; with a trace of a median carina on the dorsal part of the plate; frons with a frontal suture; silvery-white pubescent to above the insertions of the antennæ; rather sparsely, finely punctured and bearing long, black and brown hairs not quite as stout or numerous as on the clypeus; ocelli located in a curve rather than marking the corners of a triangle, the lateral ones nearer each other than they are to the eyes; vertex sparsely punctured; cheeks rather narrow, less than half the width of the eye, narrowing gradually below; with whitish sericeous showing faintly just behind the eye; sparsely punctured and with long, grayish hairs; anterior margins of the eyes slightly converging downward; antennæ black, slightly grayish sericeous in certain lights; scape quite thickly clothed with short hairs; first segment of the filament the longest; mandibles short, black, three toothed, the teeth nearly equal in length, with a faint brownish tinge between the bases of the teeth and the articulation with the head.

*Thorax*.—Neck short, broad; anterior face of the collar rising sharply and at right angles to the neck; this face rather flat from side to side, sparsely punctured and at the narrow dorsal edge faintly whitish sericeous; posterior face nearly vertical, quite closely appressed against the mesonotum; sides of the collar sparsely punct-

ured and with scattered hairs; prothoracic lobe somewhat punctured and with a posterior fringe of short brown and white hairs; mesonotum bent quite sharply downward in front, and at the sides in front of the tegulæ; its surface not closely, quite evenly, finely punctured and bearing numerous short, gray hairs; with a median impressed line on the anterior third of the plate, and traces of parapsidal lines; scutellum rather broad from front to rear, flattened; postscutellum narrow, evenly rounded; both plates punctured and clothed like the mesonotum; dorsum of the median segment closely punctured, the punctures coarser than on the preceding plates; with a slight depression a little anterior to the fovea; covered quite thickly with long, grayish-white hairs; fovea a short, transverse, impressed dash; posterior end and sides of the median segment punctured and clothed like the dorsum; mesopleura similarly, but rather more coarsely punctured, bearing long, whitish hairs; vertical part of the metapleuron above and in front of the mesocoxa rather smooth, though with a few punctures; glistening; its hinder part below the side of the median segment like this last; petiole quite long, slightly curved, finely punctured and bearing numerous long, gray hairs.

*Abdomen*.—Ovoid, more pointed in front, glistening, whitish sericeous, not rising sharply or very much above the petiole; with a few scattered, fine punctures and brownish hairs, particularly on the hinder segments; beneath similar, but with the punctures and hairs more equally distributed; the hinder margins of the fourth and fifth plates somewhat emarginate.

Wings more or less fuliginous with violet reflection, the fuliginous being most abundant on the anterior and outer margins; cubital and subdiscoidal veins of the fore wing little more than dark shades beyond the ends of the cells; discoidal vein of the hind wing interstitial; cubital vein little developed beyond the transverse cubital vein.

*Legs*.—Coxæ, trochanters and femora with scattered punctures and quite long, grayish hairs; more or less grayish sericeous at certain angles, as are the tibiæ and tarsi; spines and claws black.

*Male*.—Differs from the female as follows: Front of the clypeus with only slight projections in place of the teeth of the female and with a slight emargination between, instead of a notch; mandibles generally with a distinct ferruginous band just behind the bases of the teeth; body in general more hairy.

*Length*.—Females, 15–19 mm.; males, 13–17 mm.

*Chlorion harrisi* is a common species almost everywhere east of the Rocky Mountains. The most northern localities from which I have seen it, are Webster, Durham, and Hanover, New Hampshire; Amherst, Riverside, and Concord, Massachusetts; Sandusky, Akron, and Columbus, Ohio; Canada (exact locality not given); northern Illinois; and Fort Collins, Colorado. From the South I have seen

examples taken at Chokoloskee, Florida; New Orleans, Louisiana; Dallas, Texas; and Saussure reports it from Orizaba, Jalapa, and Cordoba, Mexico. These localities indicate that it lives in the Transition, Upper Austral and Lower Austral zones, the Mexican specimens coming from quite high altitudes.

In the Harris collection now at the Boston Society of Natural History are three specimens of this insect, each bearing the number "72." Harris's manuscript record book corresponding to these numbers reads as follows: "72. *Ammophila apicalis*, S. letter. *Sphex* probably not a true *Ammophila*. on umbellate flrs. July 25, 1825. large and small & Dublin N. H. on do. July 22, 1835. Camb. on *Asclepias* Aug. 1, 1838." I am informed by Mr. Samuel Henshaw that the expression "S. letter," probably means that Harris got the name from Say. There is therefore no longer any question that the reference to Harris for this species is correct. As the name is a *nomen nudum*, however, it can not hold as the name of this insect, and several of the more recent writers have adopted Lepeletier's *philadelphicum* as the correct name. With this view I am not at present able to agree, as Lepeletier's description fails to correspond entirely with this insect, and the type is lost. Kohl also seems now to doubt the identity of Lepeletier's insect with the one under consideration, as he writes me: "Wahrscheinlich ist *Sph. philadelphicus* Lepeletiers gar keine *Isodontia*."

The specific name *apicalis* Smith would be the next available one for this species, but unfortunately Smith had used this name for another species of the genus nine pages earlier in the same article, thus excluding it from application here in accordance with the law of place priority.

As there have been no other names applied to this insect so far as is known, a new name becomes necessary, and I have selected *harrisi* as being an appropriate one under the circumstances.

The prey of *Chlorion harrisi* consists of Tree Crickets (*Ecanthus*), but whether of more than one species is not recorded. It is illustrated as figure 1, Plate VII, of the Insect Book.

#### CHLORION (ISODONTIA) ELEGANS (Smith).

*Sphex elegans* SMITH, Cat. Hym. Brit. Mus., 1856, p. 262.

*Isodontia elegans* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 380.

*Sphex (Isodontia) philadelphicus* KOHL (in part), Ann. natur. Hofmus. Wien, V, 1890, p. 381.

*Isodontia elegans* PATTON, Ent. News, IV, 1893, p. 302.

*Isodontia elegans* ASHMEAD, Psyche, VII, 1894, p. 64.

*Sphex (Isodontia) elegans* KOHL, Ann. natur. Hofmus. Wien, X, 1895, p. 72.

*Sphex elegans* DAVIDSON, Ent. News, X, 1899, p. 179.

*Isodontia elegans* H. FERNALD, Can. Ent., XXXV, 1903, p. 269.

General body color black, more or less ferruginous to yellowish on the abdomen; wings quite hyaline with yellow tinge and somewhat fuliginous; legs partly pale ferruginous.



*Female*.—Head rather broad, the cheeks broad, giving a somewhat quadrangular outline to the head when viewed from above; clypeus somewhat arched laterally, covered with dense golden pubescence extending up on the frons to near the ocelli, particularly at the sides; both plates bearing many long golden hairs; anterior margin of the clypeus with a median notch, on each side of which it is slightly emarginate, the sides of the notch being slightly prolonged outward beyond the rest of the margin, which is a little reflexed and pale ferruginous; frons black where exposed to view, with a few punctures and numerous long, golden hairs; posterior ocelli quite far apart, but little behind the median ocellus; vertex with a number of rather fine punctures and long, golden hairs; an impressed line runs just in front of the ocelli; cheeks above, more than half the width of the eye, narrowing sharply below, slightly golden pubescent just behind the eyes; with fine punctures and long, golden hairs, longer and closer below; antennæ more or less ferruginous; scape dull, pale ferruginous to black, with numerous short hairs; pedicel varying similarly in color; filament black, slightly glistening at the joints, lusterless between; the first segment longest; mandibles short, three-toothed, the teeth and sometimes the base black, the rest ferruginous, with a very few indentations and a few long, golden hairs on the posterior face.

*Thorax*.—Collar black, its anterior face quite erect; the dorsal edge evenly rounded laterally, covered more or less closely with golden pubescence; the front and sides and dorsal edge bearing quite numerous, long, golden hairs; the posterior face closely appressed against the mesonotum; prothoracic lobe black, with scattered, long, golden hairs and a fringe of dense, short, yellow ones behind; mesonotum quite closely, rather coarsely punctured, and quite thickly clothed with rather short, golden, and paler hairs; with an anterior, median impressed double line extending back about one-third the length of the plate; scutellum somewhat arched, rather flat above, punctured and clothed a little more sparsely than the mesonotum, and with a trace of golden pubescence at the extreme side; postscutellum golden pubescent, with long, yellow hairs; dorsum of median segment quite coarsely, very closely punctured, with traces of transverse aciculation in some lights, and thickly clothed with long, golden hairs; lateral groove from the postscutellum to the stigma pronounced; fovea a short, transverse dash, below the angle between the dorsum and posterior end, which is coarsely, closely punctured, thickly covered with long, golden hairs and with a trace of golden pubescence just above and at the sides from the petiole; a golden pubescent band runs forward and upward from the hind coxa below the stigma to the side of the postscutellum; meso- and meta-pleura quite closely but rather finely punctured, least so between the two, thickly clothed with long, golden hairs; petiole quite long, somewhat curved, black, with numer-



ous rather fine punctures on the anterior half, nearly smooth behind, where it is golden sericeous, bearing long, yellow hairs.

*Abdomen*.—Black and ferruginous, the distribution of the colors variable; above, whitish sericeous, especially in some lights, and with a few short, pale hairs on the last four segments, particularly at the sides, and with scattered punctures; beneath, with a few punctures on each segment and short, pale hairs; fourth and fifth ventral plates somewhat emarginate behind; terminal plate quite evenly, rather coarsely punctured.

*Wings*.—Hyaline, slightly fuliginous along the outer border, tinged with yellowish, the veins pale ferruginous; forewing slightly fuliginous in the first and second cubital cells; discoidal vein of the hind wing interstitial; cubital vein developed only a short distance beyond the transverse cubital vein; tegulae pale ferruginous varied with paler.

*Legs*.—Coxae black; trochanters black or black and ferruginous; femora black or black and ferruginous; tibiae and tarsi pale ferruginous; coxae sericeous in places, with fine punctures and long, yellow hairs; trochanters the same; femora with many long, yellow hairs; particularly behind and beneath, the hind femora the least hairy; tibiae and tarsi yellow sericeous, their spines brownish; hind tibiae densely yellowish sericeous behind; claws pale ferruginous and black, the distribution of these colors varying.

*Male*.—Differs little from the female, but is usually more hairy, liable to have less yellow or ferruginous on the body and legs, and shows the usual sexual distinctions.

*Length*.—Females, 15–18 mm.; males, 15–17 mm.

This pretty species is western and southwestern in its distribution. I have seen specimens from Parker and Fort Collins, Colorado, taken in June and July; from Siskiyou County and other (not indicated) parts of California; from Lower California, Nevada, and New Mexico. The records from this State (mainly from Prof. T. D. A. Cockerell) are as follows: Highrolls, N. M., from May 26 to June 14, '02; Rio Ruidoso ab. 6,500 ft. Wh. Mts., July 19 and 22, on flowers of *Rhus glabra*; Rio Ruidoso ab. 7,500 ft. Wht. Mts., August 3; and La Cueva ab. 5,300 ft. Organ Mts., September 5, on flowers of *Lippia wrightii*. Patton states that it is also found in Florida, but, in the absence of any specimens from intermediate points and any other record from that State, I feel that there is likely to be some error in this record.

Kohl regard *C. elegans* as a variety of *harrisi*, a view which I am not prepared to accept at present. The former has a different distribution from the latter and is very fixed in its characters, and at present I should be as ready to regard it as a subspecies of *C. auripes* as of *C. harrisi*, at least until more evidence than we now have is forthcoming. At all events it seems that our knowledge of the species is yet too slight to unite it with any other.

The prey of *Chlorion elegans* is reported by Coquillett as being *Ecanthus niveus* De Geer.

Mr. S. Arthur Johnson, of the Colorado Experiment Station, Fort Collins, Colorado, has made some observations on the nesting habits of this species and has kindly sent me the following notes on the subject:

A number of the adults of *Chlorion* (*Isodontia*) *elegans* have been reared by the writer from cocoons taken from the nests. In all these cases they were taken from the adobe banks where *Anthophora occidentalis* makes its home.

In order to make clear the conditions, it should be explained that the latter species nests in vertical adobe bluffs where the material is so hard and dry that it is removed with the knife blade or other tool with great difficulty. The bees much prefer a southern exposure; are sometimes content with a west or east front, but seldom select a place which is not exposed to the sunshine at some hour of the day. Into this hard substance the bees burrow to a depth of from 6 to 10 inches, making the diameter about three-eighths of an inch. At the end of the burrow a cluster of urn-shaped cells is made, stored with pollen, and provided with eggs; the cells and the entrance to the burrows are sealed. In order to make way through the hard material, the bee brings water from the neighboring brook and softens the dirt; the waste material is used in part to build a curious tube-like doorway.

There is reason to believe that *Isodontia elegans* occupies only the discarded burrows of these bees or related species. I have never found the nests in other locations, nor have I found any evidence that the wasps ever dig their own nesting places. On the other hand, the entrance to their homes almost always shows signs of *Anthophora's* work, and in instances where I have dug beyond the cocoons of *Isodontia* I have found the empty cells of the bees at the end of the burrow.

The nests of *I. elegans* are made from 2 to 4 inches within the tunnel and are composed of finely chewed fibers of dead weeds and grass. The food consists of (*Ecanthus* sp. or in some cases of nymphs of grasshoppers between 5 and 10 millimeters in length. Usually there are two cocoons in the tunnel, but in one case I found four. The outer portion is tightly packed with grass stems of coarser nature than those used for the nest proper. These fibers are wound round and round the burrow and packed in very firmly and securely. The packing extends to the mouth, where it commonly protrudes slightly. Some tubes were packed with closely arranged sprigs of sage.

The cocoon is composed of fine fibers of silk, and consists of three layers. The outer is a loosely woven mass of silk which often entangles loose materials, legs, and dried parts of the food material, bits of finely chewed grass, etc. Below this is a thin, papery, pinkish layer with a shining surface which appears to be made by gluing the silk together by means of some fluid. This layer is so tight that it doubtless has much to do with regulating the degree of moisture within. The inner layer is yellowish, quite thick, more loosely woven than the middle layer, but more compact than the outer. It fills all the space between the middle layer and the pupa case.

The length of the old larval exuvia in which pupation takes place is 19 mm., breadth  $5\frac{1}{2}$  mm., elongated, almost cylindrical in form, but slightly larger at the anterior end. Color, the usual brown of Dipterous larvæ.

Three species of insects bred from these cocoons, sent me by Mr. Johnson, have been identified through the kindness of Dr. L. O. Howard, of the Department of Agriculture in Washington, as *Argyramæba* fur O. S., *Senotainia trilineata* Van der Wulp, and ?*Perilampus cyaneus* Brullé. Doctor Howard writes: "I think it very doubtful that this (the last-named species) is a parasite of the *Isodontia*, but it is likely to be parasitic upon the *Argyramæba*."

Subgenus **PROTEROSPHEX** H. Fernald.

*Sphex* KOHL, Ann. natur. Hofmus. Wein, V, 1890, p. 115.

*ProterospheX* H. FERNALD, Ent. News, XVI, 1905, p. 165.

*Type*.—*Chlorion maxillosum* Fabricius, Ent. Syst., II, 1793, p. 208.

Claws with two blunt teeth near the base of their inner border. Median segment with a stigmatal groove except in *Chlorion* (*ProterospheX*) *lucae*. Stigma of the first dorsal abdominal plate in front of the middle. Tarsal comb of the female present. Comb teeth of the hind tibial spine not tooth-like but forming a row of closely set hairs. Inner borders of the eyes parallel or converging downward. Second cubital cell of the fore wing rhombic, rhomboidal, or approaching a rectangular form, at least as broad on the cubital vein as it is high. Distance between the second and third transverse cubital veins on the radial cell less than that between the second transverse cubital and second recurrent veins on the cubital vein. Last ventral abdominal plate of the female arched. Ventral surface of the abdomen of the male usually without rows of hairs and not silky sericeous. Dorsum of the median segment generally transversely aciculate or rugose. Petiole straight. Mandibles when closed generally reaching each to the base of the other. (Plate X, fig. 25.)

**CHLORION (PROTEROSPHEX) LUCAE** (Saussure).

*Sphex lucae* SAUSSURE, Reise d. Novara, Hym., 1867, p. 41.

*Sphex belfragei* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 212.

*Sphex lucae* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 387.

*Sphex belfragei* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 439.

*Sphex lucae* PATTON, Can. Ent., XXVII, 1895, p. 280.

*Sphex belfragei* was described from "four male and female specimens found on sumach flowers in August (Belfrage)." Three female specimens from the Belfrage collection now in the U. S. National Museum are labeled "Type No. 1685." One female in the collection of the American Entomological Society is labeled in Cresson's handwriting as being this species. Apparently Cresson was in error as to the sex of some of the specimens, as his description does not apply to any of the males present in that collection, and none are labeled *belfragei*.

Body rather slender; the head and thorax black; the abdomen black to red, the two colors variously mingled in different examples, the males being generally much darker than the females; wings varying from yellowish hyaline with a fuliginous tinge to deep fuliginous with a violet reflection; legs dark ferruginous to black.

*Female*.—Head black, quite broad; clypeus quite convex, with a smooth, slightly reflexed anterior margin bearing a faint notch at the center, on each side of which is a slight tooth; its surface coarsely,



closely punctured and with long, coarse hairs bending downward, and showing traces of silvery pubescence in some cases; frons finely, closely punctured, the punctures more scattered above and almost absent near the ocelli; on the sides of the frons are traces of silvery pubescence and black hairs are also present, more scattered above and on the vertex and cheeks; vertex sparsely, finely punctured; cheeks narrow, glistening, with scattered minute punctures; eyes converging very slightly downward; antennæ black, the first segment of the filament longest, increasing slightly in diameter toward its tip; mandibles black, two-toothed, with traces of dark ferruginous.

*Thorax.*—Collar black, with fine, scattered punctures and a few short, black hairs; its dorsal edge rather rounded from front to rear, evenly rounded laterally; prothoracic lobe sparsely covered with short, black hairs and with a dense fringe of pale brown hairs behind; mesonotum black, glistening, slightly sericeous, rather closely and finely punctured and bearing scattered, black hairs, with a slight anterior median groove; its lateral margin reflexed from in front of the tegulæ to where it meets the scutellum; scutellum glistening black, very minutely punctured, with a rather deep, median groove; postscutellum similarly punctured, glistening black; dorsum of the median segment dull black, finely, transversely aciculate, thickly covered with short, white hairs; its outline sharply marked by a groove extending from the side of the postscutellum to the stigma, and thence to the fovea, the area thus marked being shield-shaped; stigmatal groove absent; sides and posterior end of the median segment dull black, minutely, closely punctured, quite thickly covered with black hairs at the sides, but mingled with white ones behind; petiole short, straight, black, sometimes slightly tinged with ferruginous, sparsely, minutely punctured, and with a few short, black hairs.

*Abdomen.*—Usually rather elongate-oval; above, smooth, somewhat glistening, pale ferruginous varied with darker, particularly on the more posterior plates; very slightly sericeous in some lights, with a few pale hairs on the hinder margin of the last plate; beneath of the same color as above, the darker areas more irregularly scattered, giving a somewhat mottled appearance; a few dark hairs are present on the second ventral plate and lighter ones on the last one, while a very few scattered hairs are present on the intervening plates.

*Wings.*—Yellowish hyaline, somewhat fuliginous on their outer margins; sometimes entirely fuliginous; second cubital cell of the fore wing rhombic; radial cell rather squarely rounded; the second and third transverse cubital veins about as far apart on the radial cell as the former and the second recurrent vein are on the cubital cell; cubital vein obsolete beyond the third cubital cell; transverse median vein of the hind wing making more than a right angle with the median vein; the discoidal vein practically interstitial; tegulæ black in front but with a trace of ferruginous behind; faintly punctured.



*Legs.*—Coxæ almost black, with a few short hairs; remainder of the legs black to dark ferruginous brown; trochanters with a number of short dark hairs; posterior tibiæ light brown sericeous behind; fore metatarsus with nine (sometimes ten) long, slender comb teeth; bases of the claws lighter than the rest of the tarsus; the claws themselves very minute.

*Variations.*—In examples with fuliginous wings the abdomen, except the first two and last plates above and beneath, is generally black. The black may also encroach on the posterior part of the second segment and on the sides of the last one.

*Male.*—Anterior margin of the clypeus extending obliquely downward and inward from the side, then transverse, slightly emarginate, a little reflexed; a faint trace of silvery pubescence sometimes present on the cheek just behind the eye, and another on the posterior end of the median segment or in some cases above the hind coxa; body rather more densely clothed than in the female; sixth and seventh ventral abdominal plates slightly emarginate behind; terminal ventral plate with its hinder border rounded at the sides, acuminate in the middle; terminal dorsal plate evenly rounded; the abdomen generally with an opalescent luster; generally black, but sometimes more or less ferruginous on the first, second, or both segments; legs usually entirely black. In other respects the male resembles the female.

*Length.*—Females, 17–22 mm.; males, 13–19 mm.

This species appears to be found only in our Southern and Western States and in Mexico. I have studied examples from Tifton and other (unnamed) places in Georgia, Texas, New Mexico (Alamogordo, taken from April 26 to June, 1902, and elsewhere); southern Arizona (F. H. Snow, August, 1902); Los Angeles County, Knight's Valley and Sonora County, California; Ormsby County, Nevada (July 6, Baker); Lewiston, Idaho; Yellowstone, Montana (August, 1883); Yakima River near Ellensburg, Washington (July 8, 1882); and from Lower California, and Guadalajara in Jalisco, Mexico.

That there is no error in placing *C. belfragei* Cresson as a synonym of *C. lucæ* is shown by the fact that a homotype of the former sent to Kohl, who studied Saussure's type, was returned marked "*Sphex lucæ* Sauss. certissime."

A picture of this insect under Cresson's name is given as figure 10, Plate XI, of the Insect Book.

**CHLORION (PROTEROSPHEX) CUBENSIS, new name.**

?*Sphex lunierii* GUERIN, Icon. d. Regne Anim. Cuv. Ins., VII, 1845?, p. 433.

||*Sphex clavipes* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 395.

A large, rather robust insect. Body to the petiole, black; petiole, abdomen and legs beyond the middle of the femora pale ferruginous. Wings quite hyaline with a yellowish tinge, slightly fuliginous on the

margins, the amount of yellow and fuliginous varying. Pubescence golden, varying in shade.

*Female*.—Head rather quadrangular from above, the front slightly rounded between the eyes; clypeus not extending far below the eyes, quite arched laterally above, thickly clothed with pubescence and long, quite stout, golden hairs; its anterior margin strongly rounded, with a pair of short, rather pointed, broad based teeth at the middle separated by a notch, and another just outside each tooth separating it from the margin; frons densely pubescent to above the level of the median ocellus, with long, golden hairs, growing shorter above; distance from a lateral ocellus to the eye about equal to that between the ocelli; vertex and occiput densely brownish-black sericeous, with numerous long, golden hairs, with an oblong-oval, slightly raised area just behind the ocelli; cheeks about two-thirds to three-quarters the width of the eyes, pubescent from near the top to near the bottom of the eye and nearly their whole width, and bearing numerous long, golden hairs, longest and largest below; inner margins of the eyes about parallel; antennæ black, black-sericeous but toward the tips rather grayish in some lights; scape with numerous rather fine punctures and short, golden hairs, particularly on the inner side; relative lengths of the filament segments  $\frac{1}{3}5$ ,  $\frac{2}{2}0$ ,  $\frac{2}{3}0$ ,  $\frac{2}{4}0$ ,  $\frac{1}{5}7$ ; mandibles long, the tip of each reaching the base of the other; black with a slight ferruginous band between the base and the bases of the teeth; their lower surface strongly longitudinally rugose (striate?); with a row of long, golden hairs on the posterior face and a few scattered ones in front.

*Thorax*.—Neck with a pubescent band crossing it above and turning backward at the sides; collar closely appressed against the mesonotum, its anterior face almost at right angles to the neck except near its base, where it is oblique for a very short distance; all except this oblique part quite thickly pubescent, least so in the middle, and with numerous long, golden hairs; dorsal edge of the collar somewhat flattened in the middle; the lower half of its lateral face black, finely punctured, the black continued down to the edge of the plate; prothoracic lobe black in front, pubescent behind, and with rather short, golden hairs; prosternum pubescent in front of each coxa, its whole surface with many long, golden hairs; mesonotum with a broad pubescent band on each side extending downward in front of the tegula to the prothoracic lobe, narrowing somewhat posteriorly and bending inward on the hind margin of the plate to meet the band from the other side; the rest of the plate densely brownish-black sericeous, velvety, except for a trace of golden pubescence along the anterior median groove and extending back about half the length of the plate, the groove itself being concealed by this; the plate also has numerous short, erect golden hairs and its lateral margin is somewhat reflexed; scutellum rather arched, very slightly notched in the middle behind,

its flattened upper surface densely brownish-black sericeous; its posterior and lateral sloping surfaces golden sericeous, almost pubescent; postscutellum golden pubescent as far to the sides as the beginning of the groove on the median segment; dorsum of the median segment entirely, very thickly pubescent, the fovea a rather short crescent; posterior end making quite a sharp angle with the dorsum, densely pubescent; sides with a broadening pubescent band running forward from above the hind coxæ to the stigma, leaving a rather narrow black-sericeous band between it and the posterior pubescence, just above the coxa; dorsum, sides and end thickly covered with erect, yellow hairs, shortest on the dorsum, and so thickly placed as to almost conceal the black band in some lights; mesopleura with a large pubescent spot just behind the prothoracic lobe and extending upward to the base of the fore wing; also with a spot (sometimes a band running upward and forward) above the middle coxæ; the rest black; somewhat sericeous, with scattered, fine punctures and numerous short, golden hairs; metapleura black in front of the pubescent band along the stigmal groove; mesosternum black, with a tendency toward golden sericeous; with scattered, fine punctures and short, golden hairs; petiole very short, stout, straight, pale ferruginous, golden sericeous, almost pubescent, and with many short, golden hairs; about half as long as the second hind tarsal segment, less than two-thirds as long as the first filament segment and about equal to the second.

*Abdomen*.—Rising quite high above the petiole, pale ferruginous, sometimes varied with darker, long and pointed at both ends, but more so posteriorly; above, pale sericeous, less so posteriorly, with a few faint punctures on the fourth plate, more and coarser on the fifth, and with many coarse ones on the terminal one, making its entire surface quite roughened; a few rather short, yellow hairs are present on the sides of the fifth plate, more and longer on the last, the extreme lateral edges of which are smooth; this plate is rather narrow and acuminate behind, but without a sharp pointed tip; beneath glistening, with a few minute, scattered punctures and short hairs, both becoming more abundant and coarser posteriorly, but absent on the middle line; on the posterior half of the last ventral plate they become quite coarse and close together, and there are numerous yellow hairs; hinder margin of the terminal plate rather narrowly obtusely rounded.

*Wings*.—Quite hyaline, distinctly yellowish half way out or more from the base, somewhat fuliginous on the outer margin, particularly at the end of the radial cell and slightly fuliginous over the entire wing, the depth of this varying in different specimens; forewing with the second transverse cubital and first recurrent veins nearly or quite interstitial; the second and third transverse cubitals much nearer on the radial than the second transverse cubital and second recurrent are on the cubital; the third cubital cell not reaching the end of the radial



cell, and the first transverse cubital vein crooked, projecting into the first cubital cell posteriorly and into the second cubital cell near the middle; hind wing with the transverse median vein almost straight, making more than a right angle with the median vein; the discoidal vein nearly interstitial; the cubital vein only a faint trace for a short distance beyond the transverse cubital, which joins the former at quite a sharp angle; tegulae brownish-black sericeous, with a pubescent spot in the middle.

*Legs.*—Coxae, trochanters, part of femora, tips, inner edges and teeth of the claws black; the rest pale ferruginous; the spines of the same color, and the hairs everywhere yellow; legs everywhere more or less pale sericeous; fore coxae with a pubescent spot in front; fore femora nearly all black; middle pair the same; hind pair about half black; fore metatarsi with eleven (sometimes ten) comb teeth, all short, the first one shortest, and with no alternating short spines; inner contour of the hind tibia sharply bent, suddenly enlarging markedly near the outer end; the hinder face of this segment strongly, coarsely, dark golden sericeous; pulvilli blackish. (Plate VI, fig. 3.)

*Male.*—Differs as follows: Clypeus squarely truncate in front; mesosternum pubescent; a pubescent band extends from the middle coxae to the spot behind the prothoracic lobe; middle and hind coxae more or less pubescent; a pubescent spot is present on the metapleural lobe; the black area at the side of the median segment is nearly concealed by the thickness of the hairs there and the extension of pubescence across; middle femora sometimes partly pubescent; last dorsal abdominal plate rounded behind, with a rather broad notch in the middle; the plate nearly as broad as the preceding one; beneath, the seventh plate is deeply and sharply excavated behind in the middle, and with a slight median ridge on its posterior half; with a thick tuft of rather short, ferruginous hairs on the posterior corners and more or less shorter hairs on the posterior margin; the terminal plate is narrow, bluntly acuminate behind and with a central depression; the surface of the last two dorsal abdominal plates is coarsely brown sericeous.

*Length.*—Females, 25–30 mm.; males, 25–28 mm.

This beautiful species has thus far been reported only from Cuba.

The identity of Guérin's *Sphex lanierii* does not seem to have been settled with certainty, and I can not learn the whereabouts of the type. Kohl regards it as a synonym of *Chlorion ichneumonaeum* Linnaeus, though Guérin writes: "Il ne faut pas confondre cette espèce avec le *Chlorion ichneumonaeum* de Fab., ou son *Sphex aurulentus*." Specimens of *C. cubensis* in the collection of the American Entomological Society are labeled *lanierii* in Cresson's handwriting, showing his opinion on the subject, and Guérin's description agrees quite well with this insect. In any case Kohl's name can not hold, being preoccupied.



## CHLORION (PROTEROSPHEX) LAUTUM (Cresson).

*Sphex lauta* CRESSON, female, Trans. Am. Ent. Soc., IV, 1872, p. 212.

*Sphex chrysophorus* KOHL, female, Ann. natur. Hofmus. Wien, V, 1890, p. 399.

*Sphex lautus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 447.

*Sphex lanciger* KOHL, male, Ann. natur. Hofmus. Wien, X, 1895, p. 55.

*Types*.—Described from five specimens, indicated as females (probably one of these was the variety also mentioned, leaving four real types). One male is now in the collection of the American Entomological Society, labeled "*S. lauta* Cr.," in Cresson's handwriting; and another specimen, also a male, from Texas, is also present. In the collection of the U. S. National Museum are two specimens from "Texas, Belfrage," marked "Type No. 1687." These are male and female. In the collection at the Museum of Comparative Zoology, of Harvard College, Cambridge, Massachusetts, is a female specimen marked "Dallas, Tex., Boll., 46, Type 521, *Sphex lauta* Cr." As the five specimens came from "Belfrage, Boll, Heiligbrodt," this would account for all except the Heiligbrodt material, which is probably that retained by Cresson at Philadelphia. It would seem that the sexes were not correctly given in the printed description.

The following description was prepared from the National Museum types, with additional notes from other specimens:

Large, robust, body to and including the petiole black; abdomen pale ferruginous; wings hyaline; pubescence abundant, golden yellow.

*Female*. Head broad, rounded oval from above, the cheeks though broad being retreating; clypeus covered everywhere except on the very anterior margin with dense golden yellow pubescence continued up over the frons to the level of the ocelli, the surface also bearing very numerous, long yellow hairs; anterior margin of the clypeus strongly rounded, with a hollow at the middle, from which arise two broad, blunt teeth the tips of which extend to the outline of the general curve of the margin, and between which is a shallow notch; vertex black sericeous, very minutely punctured; just behind the ocelli is an oblong-oval, slightly elevated, velvety black area; the entire vertex with scattered, short yellow hairs; cheeks nearly as broad as the eyes, but sloping inward quite sharply; with a dense golden pubescent spot near the middle and with many long yellow hairs below and behind this spot; inner margins of the eyes parallel; antennæ dull black, the scape quite stout, very slightly sericeous or pubescent beneath and with a few longer yellow hairs on the upper and inner sides; first segment of the filament the longest, its diameter a little the greatest near its outer end; mandibles large, stout, dark ferruginous, particularly on the large, stout terminal tooth, with short longitudinal aciculations on the under surface of the basal portion, and with long yellow hairs behind.

*Thorax*.—Collar narrow, its anterior and posterior faces nearly vertical, not appressed against the mesonotum; its entire anterior face and dorsal edge thickly clothed with golden yellow pubescence, least dense in the middle, and bearing long yellow hairs; the pubescence does not extend far down at the sides, exposing the black, minutely punctured surface; prothoracic lobe black, the upper three-fourths of its posterior half covered with golden yellow pubescence and short yellow hairs, the pubescence almost meeting the mesonotal band; its hinder margin with a fringe of short pale hairs; mesonotum with a faint anterior, median, impressed line or narrow band; its central area velvety black; at each side a broad pubescent band extends from just above the prothoracic lobe upward to above the tegula, then back to the hinder end of the plate, narrowing as it goes, then turns inward to meet the band from the other side, the two becoming very narrow behind and barely meeting; a reflexed margin is present on the plate from near the front of the tegula to a short distance in on the posterior margin; the black area of the mesonotum bears many short pale yellow hairs; scutellum black, with a median longitudinal depression; very minutely punctured and sericeous; postscutellum golden pubescent as far laterally as the groove on the median segment leading to the stigma; median segment dorsum and posterior end thickly covered with golden pubescence and long yellow hairs, which do not conceal the grooves which mark the limits of the dorsum nor the fovea; a band of pubescence follows the lateral edge of the dorsum from the postscutellum to the stigma, and thence on both sides of the stigmatal groove to the hind coxa; a space between this band and the pubescence on the posterior end is black, with scattered punctures, and extends to the side of the petiole; mesopleuron with a large golden pubescent spot just behind the prothoracic lobe, with a slight extension upward and forward toward the tegula; just above and in front of the anterior coxæ is a triangular pubescent area extending toward the neck; under surface of the thorax yellow sericeous, in places almost pubescent, with long yellowish hairs, abundant except on the prosternum; petiole short, straight, black, strongly sericeous, almost yellow pubescent, with short yellow hairs.

*Abdomen*.—Elongate oval, a little longer than the thorax, not quite as wide at its widest place as the distance between the outer edges of the tegula; its color above ferruginous, the posterior margins of the plates a little darker, and on the third, fourth, and fifth plates this shade is carried forward on the median line toward the middle of the plate; the entire surface sericeous, smooth, except the terminal plate, which is coarsely punctured and bears a number of long yellowish hairs; beneath, the same color as above, but with darker markings, more irregular in form and position, giving a somewhat mottled appearance; there are a few yellowish hairs at the sides on each plate,

increasing in number backward, and a few scattered punctures occur, particularly on the terminal plate.

*Wings*.—Yellowish hyaline, a little fuliginous on the outer margin of the fore wings, the yellowish being a little deeper toward the base; first recurrent vein of the fore wing nearly or entirely interstitial with the second transverse cubital; the second and third transverse cubitals very close together on the radial; cubital vein of the hind wing with a slight backward bend near its middle; obsolete beyond the transverse cubital; the discoidal vein not quite interstitial; tegulae black, faintly sericeous, with a trace of yellow pubescence near the center; the outer edge slightly reflexed.

*Legs*.—Coxae, trochanters and femora black; sericeous, particularly beneath; fore femora yellow pubescent beneath and on the lower part of the outer side; fore and middle tibiae and tarsi sericeous above, dark ferruginous, the tips of the claws black; fore metatarsi with ten comb teeth, shorter than half the length of the metatarsus; hind tibiae sericeous, with a dense brown band, coarser than elsewhere, on the posterior face; inner edge of the hind tibia not straight, but curved, hollowing along its middle, rather dilated at the ends. (Plate VI, fig. 4.)

*Male*.—Differs from the female in the following respects:

Generally more pubescent; the pubescent spot behind the prothoracic lobe larger and extending downward to connect with the spot above the middle coxa; the first recurrent vein not quite as nearly interstitial with the second transverse cubital as in the female; abdomen less oval, being quite broad at the tip; the last dorsal abdominal plate with a slight excavation at the side, behind; thence evenly rounded except for a very slight median emargination; seventh ventral abdominal plate with a weak median carina; its lateral margin curving evenly toward the middle line for some distance, then with a broad, deep notch; with a slight, broad depression running from the base of the carina outward and backward to the posterior angle where the notch begins and a tuft of yellowish hairs just outside this depression, on the margin of the plate; terminal plate small; its posterior margin evenly rounded, with a circular depression in the center of the plate.

*Variations*.—In some specimens the black band between the pubescence along the stigmal groove and that on the dorsum and hinder end of the median segment is encroached upon by the pubescence; the abdomen is almost fringed on the hinder margins of the last two or three dorsal plates with short, pale hairs; the median excavation on the hinder margin of the last dorsal plate is sometimes quite pronounced; the mesosternum may be distinctly pubescent, and the hind wings may be slightly fuliginous on the outer border; abdomen sometimes varied with dark.

*Length*.—Females, 24–27 mm.; males, 24–26 mm.

This is one of our most beautiful species of *Chlorion*, its brilliant pubescence and ferruginous abdomen making it very noticeable, though in some cases the latter is darker and consequently less prominent. It is found rarely in the Southern States, examples having been taken in North Carolina; Cameron and New Orleans, Louisiana; (July, and August 20, 1903); and in Texas (Dallas and elsewhere).

Cresson in his original description refers to a variety having a black abdomen, of which he had one specimen, and says: "Should the variety with black abdomen prove to be a distinct species, it may be named *illustris*." This insect is Say's *Sphex habena*, and as its sub-specific relation to *lautum* Cresson has not as yet been demonstrated it is included in this paper under Say's name.

**CHLORION (PROTEROSPHEX) HABENUM (Say).**

*Sphex habena* SAY, Ins. of Louisiana, 1832, p. 14.

*Sphex habena* SAY, LeConte ed., I, 1859, p. 308.

*Sphex lautus* var. *illustris* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 210.

*Sphex lautus* var. *illustris* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 447.

*Sphex habena* KOHL, Ann. natur. Hofmus. Wien, X, 1895, p. 70.

*Type*.—Say's type was from Louisiana. It is no longer in existence. Cresson's type of *lautus* var. *illustris* is in the collection of the American Entomological Society in Philadelphia, where I have studied it with care.

Body everywhere black; legs black; pubescence golden; wings hyaline, tinged with yellow, their outer margins somewhat fuliginous; large, robust insects.

*Female*.—Head quite large, quadrangular, the eyes and cheeks being quite full; clypeus and frons to the ocelli densely pubescent and with many long, golden hairs, longer and stouter on the clypeus; front margin of the clypeus evenly, strongly rounded, with a hollow at the middle, from which arise a pair of broad, blunt teeth, separated by a notch; frons above the pubescence, the vertex and the cheeks, except where pubescent, sericeous black with a dark brownish tinge; distance between the lateral ocelli less than between them and the eyes; just behind the ocelli is a transverse-oval, slightly raised area; frons, vertex, and cheeks with scattered punctures and rather long, golden hairs, the latter being coarsest and longest on the lower part of the cheeks which at their middle are nearly as wide as the eyes; behind the middle of the eye is a rather triangular pubescent spot; inner margins of the eyes parallel; antennæ black, the scape with numerous short, yellow or golden hairs, particularly on the inner side; filament black sericeous, velvety; relative length of the filament segments  $\frac{3}{3}$ ,  $\frac{2}{2}$ ,  $\frac{1}{1}$ ,  $\frac{1}{1}$ ,  $\frac{5}{1}$ ; mandibles black, stout, two-toothed, the terminal tooth extending beyond the base of the other mandible; their anterior surface with numerous slightly oblique striæ or aciculations; posterior edge with a



row of long, golden hairs; the edge and tip of the terminal tooth faintly tinged with ferruginous.

*Thorax*.—Collar not closely appressed against the mesonotum, its faces nearly vertical, the anterior one slightly oblique to the neck for a very short distance at its lower part; the anterior face and dorsal edge pubescent and with numerous long, golden hairs; neck black above in the middle, pubescent laterally; dorsal edge of the collar slightly flattened near the middle; its sides pubescent about half way down, then black; prothoracic lobe black in front, pubescent on its posterior half, with numerous yellow hairs; prosternum black, with a pubescent spot in front of each coxa; with quite numerous medium-sized punctures and hairs; mesonotum with a broad, pubescent band on each side, beginning just above the prothoracic lobe, passing up around the tegula, then backward to the posterior end of the plate where it turns inward, becoming narrower, and meets the band from the opposite side; the middle of the plate densely black, sericeous, almost concealing the anterior median groove, which appears to extend back about one-third the length of the plate; there are numerous short, erect golden hairs over the entire surface of the mesonotum; scutellum black sericeous, with a slight median groove visible at some angles; postscutellum densely pubescent; dorsum of the median segment densely pubescent and with many rather short, erect, golden hairs; fovea crescentic, rather narrow; posterior end from the fovea to the petiole covered by a large, squarish pubescent spot, its sides somewhat rounded; there is also a pubescent band along the side, against the stigmal groove; between this and the posterior pubescent square, and on a narrow strip running inward above the square to the fovea the black surface of the plate is visible, its surface slightly roughened; posterior end and sides with quite numerous long, golden hairs; mesopleura with a small pubescent spot above and slightly in front of the coxæ and a large spot behind the prothoracic lobe, a portion of which extends forward in front of the lobe to the edge of the mesonotum in front of the tegula; the remainder black, with fine, scattered punctures and somewhat pale sericeous in places, and with numerous, long and short, golden hairs distributed over the entire pleura; metapleura with a pubescent band, its posterior half sometimes paler, running from the hind coxæ along the stigmal groove and side of the dorsum to the postscutellum, wider in front; the rest of the plate pale sericeous, with quite numerous, fine punctures and golden hairs varying in length; mesosternum yellowish sericeous, and with many rather short, golden hairs; petiole black, straight, pale sericeous, and with numerous short, yellow hairs; but little more than half as long as the second hind tarsal segment.

*Abdomen*.—Rather broad and stout, rising upward quite sharply behind the petiole; about equally pointed at the ends; grayish seri-

ceous, particularly so except on the last three segments above; surface smooth, with a very few faint punctures on the fourth plate, located rather at the sides and behind; with more on the fifth, somewhat coarser and with a few short black hairs; sixth plate coarsely punctured everywhere except close to the hind margin at the sides, and with a number of quite long black or brownish-black hairs; hinder margin of the fifth plate very slightly, broadly acuminate; the last plate narrow, acuminate, the tip blunt and with its middle rather flattened; beneath smooth on the first three plates except for a minute puncture and short black hair here and there; the last three plates with punctures and hairs increasing in number and size going backward; the last plate quite generally punctured except on the middle line, though not as coarsely as the last dorsal plate; its outline conical, the hinder margin evenly rounded; with quite a number of long, black or brownish-black hairs.

*Wings*.—Yellowish hyaline to the outer ends of the cells; the outer margins slightly fuliginous; fore wing with the first transverse cubital vein bent a little into the second cubital cell; first recurrent vein almost interstitial with the second transverse cubital; second and third transverse cubital veins less than half as far apart on the radial vein as the second transverse cubital and second recurrent are on the cubital vein; hind wing with the transverse median vein slightly arched outward at its middle, making more than a right angle with the median; discoidal vein almost interstitial; only a trace of the cubital vein present beyond the transverse cubital, which is oblique to the other; veins brown; tegulae brownish-black, very minutely punctured, with a pubescent spot near the middle.

*Legs*.—Everywhere pale (gray?) sericeous when viewed at certain angles; fore femora with a broad pubescent band behind and numerous short golden hairs; fore coxae sericeous, almost pubescent in front; fore metatarsi with ten short comb teeth, not alternating with short spines; hind tibiae heavily brown and gray sericeous behind; their inner contour slightly curved, hollowing in the middle; outer margins of the claws except the tips piceous; spines black.

*Male*.—Unknown.

*Length*.—Females, 26–28 mm.

Of this beautiful species only four specimens are known to me in any of the collections in this country. Say's original specimen was from Louisiana. The four now known were captured and are now located as follows: Cresson's type was taken in Texas and is in Philadelphia; the U. S. National Museum has a specimen marked "Miss. Agl. Coll. H. E. Weed.;" at the Museum of Comparative Zoology in Cambridge, Massachusetts, is a third specimen labeled "Dallas, Tex., Boll," and the fourth is in my own collection, captured in Alta Mira, Tamaulipas, Mexico, June 29, 1903.

It is possible that Cresson's suspicion that this insect will prove to be a subspecies of *lautum* may yet prove to be correct, in which case *habenum* Cresson will become the specific name, while *lautum* will become that of the subspecies with the red abdomen. This suspicion is still far from being proved, however.

It should be noted here that the insect identified by Cresson as *habena* Say, and going by this name in many collections, is quite different from the real *habenum* and does not agree with Say's description in many ways. It is really *C. spiniger* Kohl.

#### CHLORION (PROTEROSPHEX) TEPANECUM (Saussure).

*Sphex tepanecus* SAUSSURE, Reise d. Novara, Hym., 1867, p. 41, pl. II, fig. 23.

*Sphex mexicana* TASCHENBERG, Zeits. f. d. ges. Naturw., XXXIV, 1869, p. 416.

*Sphex tepaneca* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 33.

*Sphex mexicana* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 34.

*Sphex tepanecus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 401.

Robust, black except on the basal half of the abdomen and on parts of the femora; wings hyaline with a strong yellowish tinge to the outer ends of the cells, the outer margins somewhat fuliginous; without pubescence except on the head.

*Female*.—Unknown.

*Male*.—Head quite broad, somewhat quadrangular from above, but with the cheeks retreating more from the corners of the quadrangle than do the eyes; entire clypeus and sides of the frons to above the antennæ covered with silvery pubescence, which is very smooth and satin-like on the clypeus, along whose sides are numerous long black hairs; its anterior margin rather rounded truncate, black, not reflexed; on the sides of the frons the black hairs are longer and more abundant, as well as along the middle line of this plate; the remainder black sericeous; lateral ocelli about equidistant from the eyes and from each other; vertex, occiput, and cheeks black sericeous, the last two with numerous long black hairs, particularly long and abundant below; inner borders of the eyes about parallel; antennæ black, the outer part rather brownish sericeous; scape with a brownish tinge at the outer end; the first segment of the filament black; relative length of the filament segments  $\frac{1}{4}5$ ,  $\frac{2}{6}$ ,  $\frac{3}{6}$ ,  $\frac{4}{6}$ ; mandibles at base and on the teeth to their bases black; elsewhere ferruginous, with a few short longitudinal rows of striæ containing deeper punctures; two-toothed, the terminal tooth nearly reaching the base of the other mandible; with scattered long black hairs on the hinder face; head not as broad as the distance between the outer edges of the tegulæ.

*Thorax*.—Densely clothed with quite short, erect, black hairs; anterior face of the collar almost vertical, the posterior face closely appressed against the mesonotum; with many quite long, black hairs; dorsal edge of the collar somewhat flattened in the middle; prothoracic lobe with quite a thick fringe of short brown hairs behind; median



groove of the mesosternum partly concealed by the clothing, apparently rather broad and extending back about half the length of the plate; scutellum with a slight median groove not perceptible on the postscutellum; between these two plates, projecting forward from the latter, is a fringe of very short brown hairs; dorsum of the median segment well clothed with many black hairs of medium length; with a rather pronounced median depression, deepest about two-thirds the length of the plate from the front; fovea rather elongated crescent; dorsum and posterior end of the median segment nearly at right angles; posterior end and sides thickly covered with long black hairs; pleura and sterna black, with long black hairs, except above the middle coxae, where it is quite glabrous; petiole short, stout, straight; its length, as compared with the second and third hind tarsal segments, being 28-45-33.

*Abdomen.*—Large, stout, high, rising sharply from the petiole; its first, second, and all but the posterior margin of the third dorsal plate reddish ferruginous; the rest black, somewhat sericeous; the next to the last dorsal plate with quite numerous punctures and a few short, black hairs at the sides; the terminal plate with a rather large, shallow, median depression near its base; its posterior edge rounded, somewhat truncated in the middle, and its posterior half with numerous coarse punctures and black hairs beneath; the first two and the anterior corners of the next two plates reddish ferruginous, the others black; the surface not sericeous; with a few scattered punctures anteriorly, increasing in abundance posteriorly, and with a few short, black hairs on the sides of the more posterior plates; the terminal plate closely covered with short, erect, brownish and blackish hairs; its sides somewhat rounded, its end quite truncate; tips of the protruding genitalia ferruginous.

*Wings.*—Strongly yellow (reddish at the base) to the ends of the cells, the outer margins somewhat fuliginous; second recurrent vein of the fore wing joining the cubital vein in the second cubital cell near the second transverse cubital vein; the distance from the second transverse cubital vein to the third on the radial vein but little more than that from the former to the second recurrent vein on the cubital vein; the first transverse cubital vein bending somewhat into the second cubital cell; the cubital and subdiscoidal veins beyond the cells are fuliginous and there is a darker streak of the same beyond the end of the radial cell; the cubital vein of the hind wing continues nearly straight from the junction of the median and transverse median veins, the discoidal being not quite interstitial; the cubital vein is well developed beyond the transverse cubital, which joins it almost at a right angle, being itself only slightly curved; tegulae black.

*Legs.*—Black, except the fore femora beneath, where they are ferruginous, and the middle femora beneath, where there is a trace of



the same color; fore femora much compressed laterally; spines of the legs black; the claws near their middle with a faint ferruginous tinge; inner contour of the hind tibiae quite straight, their hind surface densely brownish sericeous; hind metatarsi considerably curved.

*Variations.*—This description has been prepared from the two specimens I have seen. Kohl's description differs in some regards, which are therefore given here as follows: Face clothed with white or yellow pubescence; inner margins of the eyes very slightly converging downward; lateral ocelli farther apart than they are from the eyes; petiole about as long as the second hind tarsal segment.

*Length.*—Males, 25–31 mm.

All the specimens of this species except one have been captured in Mexico, but I find no data as to the exact locality. This exception was taken in August, 1905, at Carr Canyon, Cochise County, Arizona, by Dr. Henry Skinner. Its most striking features seem to be the curve of the posterior metatarsi and the reddish color on the abdomen, this being quite reddish ferruginous, with (in the examples I have seen) a distinct carmine shade.

**CHLORION (PROTEROSPHEX) FLAVITARSIS, new name.**

?*Sphex opaca* DAHLBOM, Hym. Eur., I, 1845, p. 437.

*Sphex flavipes* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 263.

?*Sphex tibialis* SAUSSURE, Reise d. Novara, Hym., 1867, p. 39.

*Sphex opaca* TASCHENBERG, Zeits. f. d. ges. Naturw., XXXIV, 1869, p. 413.

*Sphex flavipes* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 382.

*Sphex flavipes* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 404.

*Sphex flavipes* H. FERNALD, Psyche, X, 1903, pp. 202–204.

Large, quite robust; the body black; outer portion of the legs rusty yellow; wings fuliginous with a slight violet reflection; hairs yellowish; pubescence yellow.

*Female.*—Head broad, black, covered with long, yellowish hairs; clypeus somewhat arched, its anterior edge rounded, with a slight notch in its middle separating two very short, rather blunt teeth; the surface of the clypeus yellow pubescent as is also that of the frons to above the insertion of the antennæ; vertex very minutely punctured and with scattered, larger punctures; cheeks narrow behind the eyes, about half the width of the eye, with long, coppery-yellow hairs, and yellow pubescent near the middle below; inner margins of the eyes about parallel; antennæ black, the scape with a few yellowish hairs and slightly yellowish pubescent inwardly and beneath; first segment of the filament the longest; mandibles long, two-toothed, black at the base and at the tip of the anterior and all of the terminal tooth, the remainder ferruginous.

*Thorax.*—Collar black, with scattering yellow hairs and a narrow, yellow, pubescent band on the dorsal edge; prothoracic lobe yellow pubescent, particularly behind; mesonotum covered with short, yel-

low hairs and with a pubescent band running from near the front of the tegulae, on the edge of the plate, backward to its hinder margin, then inward along that margin till it barely meets the band from the other side; scutellum black, covered with short, pale yellowish hairs; with a hint of a pubescent band along its posterior edge; post scutellum narrow, covered with pubescence; median segment thickly clothed with long, yellowish hairs; with a large, squarish, yellow pubescent spot above the petiole, divided on the medianline; sides of the thorax sparsely clothed with yellow hairs and with a pubescent spot on the mesopleuron just behind the prothoracic lobe, which extends upward to near the base of the fore wing; beneath rather more densely clothed than on the sides, with longer hairs; petiole short, straight, with pale yellow hairs and with a tendency toward pale yellow pubescence behind; sometimes the dorsum of the median segment shows faint transverse aciculations.

*Abdomen.*—Black, very finely sericeous, the last four dorsal plates coarsely punctured on each side of the middle line; the last two with dark yellow hairs; beneath with scattered punctures and long, dark yellow hairs, particularly on the last two plates.

*Wings.*—Fuliginous with a slight violet reflection; the hind wing with the cubital vein bending sharply forward beyond its junction with the discoidal, which is not interstitial, and giving off (in all specimens I have seen) a short vein bending back into the median cell; becoming a mere deeper shade beyond the transverse cubital vein; the transverse median vein straight, making more than a right angle with the median vein; tegulae partly black, partly dull ferruginous, with slight yellow pubescence on the anterior portion.

*Legs.*—Coxae, trochanters, and varying portions of the femora black; the remainder of the legs rusty yellow, the claws darker, their tips black; spines the color of the legs or a little darker; coxae, trochanters and femora more or less sericeous, the coxae with a few pale hairs; inner contour of the hind tibia straight, the posterior surface strongly pale brownish sericeous; fore metatarsus with nine or ten comb teeth alternating more or less with short spines.

*Male.*—Differs from the female in being generally more thickly pubescent and hairy; the last dorsal abdominal plate is narrow from front to rear and its posterior margin is somewhat emarginate its whole width; beneath, the last plate broadly, bluntly rounded, with a short, acuminate point in the middle and a median ridge extending to the anterior margin, across the plate; the anterior margin of the clypeus is rounded, slightly emarginate in the middle, and without teeth.

*Length.*—Females, 24–32 mm.; males, 22–32 mm.

This species, which is not common, has been captured in Georgia, Mississippi, and Texas, according to the data on the specimens I have

seen. The subspecies *saussurei* occurs in Mexico, from which country I have also seen an example of the subspecies *iheringii*, which is more common in South America. The subspecies *guatemalensis*, though first taken in Guatemala, has also been found in Mexico.

A figure of this insect is given in the Insect Book (Plate XI, fig. 8.)

**CHLORION (PROTEROSPHEX) FLAVITARSIS SAUSSUREI, new name.**

|| *Sphex hirsutus* SAUSSURE, Reise d. Novara, Hym., 1867, p. 40.

*Sphex hirsuta* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 31, pl. III, figs. 3, 3a.

*Sphex flavipes* var. *hirsutus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 405.

This subspecies differs from the typical form just described by the color of the wings, which are hyaline with a strong yellow tinge and only slightly fuliginous beyond the ends of the cells. The pubescence is more abundant, the body more hairy, there is no short vein entering the median cell of the hind wing from the cubital vein in the specimens I have seen, and the average size seems to be somewhat greater, the females ranging from 29 to 32 mm., and the males from 26 to 30 mm. in length.

This subspecies occurs in Mexico, but I have no closer data of localities.

**CHLORION (PROTEROSPHEX) FLAVITARSIS GUATEMALENSIS  
(Cameron).**

*Sphex guatemalensis* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 32, pl. III, figs. 4, 4a.

*Sphex flavipes* var. *guatemalensis* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 405.

This subspecies differs from the typical form in the following regards: The abdomen is partly ferruginous, varying in amount; the wings are quite hyaline, though with the outer margins slightly fuliginous and the inner portion tinged somewhat with yellowish, the veins dark; the pubescence and hairs, though golden, are rather pale, particularly the latter, and the outer half of the femur is ferruginous. The size is about that of average examples of the typical form.

Though first described from Guatemala, I have seen a male which was taken at Tuxpan, Jalisco, Mexico; September 3 (1902?).

**CHLORION (PROTEROSPHEX) FLAVITARSIS IHERINGII (Kohl).**

*Sphex flavipes* var. *iheringii* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 405.

*Sphex flavipes* var. *iheringii* FOX, Proc. Acad. Nat. Sci. Phila., 1897, p. 377.

In this subspecies the abdomen is black; the coxæ, trochanters and a little of the base of the femora black, also the tips, inner margins, and teeth of the claws; the tips of the hind tibiae and all of the hind tarsi are black, the spines ferruginous; the wings are strongly fuliginous, with a pronounced violet to blue reflection; the pubescence

and hairs are golden in front, but become paler behind; in one specimen seen there is a trace of the vein entering the median cell of the hind wing from the cubital vein. The size is about that of the typical form or perhaps a little less.

The habitat of this subspecies is now extended northward from Argentina and Brazil, from which countries it has already been recorded, by the discovery of a specimen in the collection of the American Entomological Society from Mexico, the exact locality not given.

**CHLORION (PROTEROSPHEX) NUDUM (H. Fernald).**

*Sphex nudus* H. FERNALD, Psyche, X, 1903, p. 201.

*Types*.—Described from six male specimens. These cotypes are now one each in the collections of the U. S. National Museum, American Entomological Society, and the Massachusetts Agricultural College, Amherst, Massachusetts, and three in the collection of their captor, Mr. J. C. Bridwell.

Insects of medium size; body black; legs beyond and including the outer ends of the femora yellow ferruginous except the last tarsal segment and claws, these and the proximal leg segments being black; pubescence pale straw color, almost silvery; hairs yellowish-white; wings nearly hyaline, the front pair slightly brownish.

*Female*.—Unknown; probably *Chlorion (Proterosphex) bridwelli* H. Fernald.

*Male*.—Head black, covered with long, yellowish-white hairs; clypeus somewhat arched laterally, its anterior margin rounded at the sides, transverse or even slightly emarginate in front, not reflexed, its surface quite thickly covered with pale straw pubescence and with many quite long, yellowish-white hairs; frons similarly clothed with pubescence and hairs to about the level of the insertion of the antennae, and above them at the sides, with a rather scattered tuft of long hairs on the middle line just above the antennae; frontal suture perceptible for a short distance below the median ocellus; the upper part of the frons blackish sericeous, dull; vertex and cheeks rather finely punctured and bearing quite long, whitish hairs, longer and closer on the lower part of the cheeks, which are nowhere half the width of the eye, and which retreat sharply toward the neck, making the outline of the head as seen from above quite oval; antennae black, the scape with short, pale straw-colored hairs; the first segment of the filament longest; mandibles black at base and from the bases of the teeth to their tips; elsewhere ferruginous.

*Thorax*.—Collar with faint, scattered punctures and a few pale hairs and with a trace of yellowish-white pubescence on its dorsal edge; its anterior face rising sharply from the neck; its posterior face somewhat closely appressed against the mesonotum; prothoracic lobe black,



its posterior portion somewhat pubescent, fringed behind with short, pale hairs; mesonotum somewhat punctured, with short, grayish-white hairs, and a faint median longitudinal groove on its anterior third; scutellum rather more sparsely and finely punctured, with a slight median depression, and covered with short, grayish-white hairs; postscutellum pale yellowish-white, pubescent as far laterally as the groove at the side of the dorsum of the median segment, this pubescence often being in part or entirely absent; dorsum of the median segment finely, transversely aciculate, covered with yellowish-white hairs longer than those of the mesonotum and scutellum; above the petiole are two yellowish-white pubescent areas partly confluent on the middle line; petiole short, straight, black, with yellowish-white hairs.

*Abdomen*.—Above, smooth, gray sericeous, very faintly punctured, the last two plates bearing grayish and brownish hairs directed backward; the terminal plate rounded, somewhat compressed on its posterior half at the sides, forming a slight median ridge; beneath, glistening, somewhat sericeous, with a few scattered grayish hairs, which on the fourth, fifth, and sixth ventral plates become tufts, one on each side, on each plate; seventh plate somewhat emarginate on its posterior margin; terminal plate rounded at the sides, acuminate at the middle, behind, giving the plate the same form as that found in *C. flavitarsis*.

*Wings*.—Nearly hyaline, the front pair very slightly fuliginous; end of the radial cell rather squarely rounded; cubital vein a mere shadow beyond the ends of the cells; transverse median vein making more than a right angle with the median vein in the hind wing; the cubital vein only a faint shade beyond the transverse cubital; tegulae black, the margin more or less ferruginous; pale sericeous near its center.

*Legs*.—Coxae, trochanters, greater portion of the femora, last tarsal segment and claws black or very dark; the rest of the leg and the tips of the claws and the spines yellow ferruginous; coxae sparsely punctured, sericeous, with a few scattered hairs.

*Length*.—Males, 18–22 mm.

I have studied specimens of this species from Tennessee, Georgia, and Maryland. Most of the specimens known were captured August 23, 1902, at Indian Head, Maryland, by Mr. J. C. Bridwell on the flowers of *Monarda punctata* Linnaeus in company with *C. bridwelli* H. Fernald, and I am of the opinion that these two will ultimately prove to be the two sexes of the same species. The yellow legs and general appearance of *C. nudum* are so suggestive of *C. flavitarsis* that it is probable that specimens of the former species are in many collections under the latter name.

## CHLORION (PROTEROSPHEX) BRIDWELLI (H. Fernald).

*Sphex bridwelli* H. FERNALD, Psyche, X, 1903, p. 202.

*Types*.—Six females, one each in the collections of the U. S. National Museum (Type, Cat. No. 9907 U.S.N.M.), the American Entomological Society, and the Massachusetts Agricultural College in Amherst, Massachusetts, and three in the collection of J. C. Bridwell, their captor.

Insects of medium size; body black and glistening; legs black to near the ends of the femora, the tibiae and tarsi, except the last segment of the latter, yellow ferruginous; wings strongly fuliginous, with a blue or violet reflection.

*Female*.—Head somewhat quadrangular with rounded corners when viewed from above; with scattered dark and yellowish hairs; clypeus arched, its anterior margin reflexed, rounded, with a small central notch and the part of the margin nearest the notch projecting a little beyond the general line of curvature; the surface of the clypeus with traces of golden pubescence at the sides, and with scattered, coarse punctures, many very minute ones, and long, yellowish-brown hairs; frons sparsely punctured, golden pubescent at the sides to above the bases of the antennae, and bearing numerous pale and dark hairs; frontal suture evident; ocelli located in a triangle marked by impressed lines, the lateral ocelli slightly nearer each other than they are to the eyes; vertex very minutely punctured and also sparsely, more coarsely so, bearing scattered, dark hairs; cheeks rather more than half the width of the eye, narrowing quickly below, with numerous fine and a few coarse punctures and scattered hairs, longer and coarser below; inner margins of the eyes parallel; antennae black except the outer part of the scape which is more or less dull ferruginous brown beneath and bears a few dark hairs; first segment of the filament longest; the outer half of the filament a little grayish; mandibles with their teeth and base black, the rest a rather pale ferruginous; with scattered aciculations and hairs on the anterior face and a row of long hairs on the outer margin.

*Thorax*.—Collar very flat laterally on its anterior face, rising sharply, almost at right angles to the neck, its dorsal edge narrow, quite evenly rounded, its posterior face vertical, somewhat closely appressed to the mesonotum; its surface minutely punctured and bearing long, dark and pale hairs; its sides rather glistening; prothoracic lobe with a thick fringe of pale brown hairs on its posterior margin; mesonotum quite evenly covered with punctures of medium size and very many minute ones; with a rather broad, anterior, median groove extending back nearly half the length of the plate; the sides of the plate with a slightly reflexed margin extending from the front of the tegulae to the hinder margin; with a few short, scattered, erect hairs; scutellum quite

large, with a distinct median depression, punctured like the mesonotum but a little more sparsely; postscutellum faintly punctured, rather more hairy than the scutellum, with a faint median depression; dorsum of the median segment very finely transversely aciculate, thickly clothed with short, erect, whitish hairs, which do not conceal the plate beneath; fovea crescentic, at the angle between the dorsum and posterior end, which is rounded, but, as a whole, nearly a right angle; posterior end and sides quite closely covered with long, whitish hairs and sometimes with a small, pale yellowish pubescent spot on each side, just above the petiole; meso- and metapleura rather sparsely, not very coarsely punctured and bearing scattered whitish hairs; petiole black, short, straight, with a few whitish hairs.

*Abdomen*.—Somewhat sericeous above, particularly on the anterior segments, smooth except the last two plates, which are coarsely punctured and bear short, brownish hairs, the punctures being more abundant on the hinder plate; beneath glistening, with extremely minute punctures, and here and there a larger one anteriorly, these becoming more abundant posteriorly till they are quite abundant on the last two plates; this distribution of punctures coincides with that of the short, brown hairs also present.

*Wings*.—Uniformly fuliginous, with a blue or violet reflection; cubital vein of both pairs of wings obsolete beyond the ends of the cells; transverse median vein of the hind wing somewhat curved, making hardly more than a right angle with the median vein; tegulae dull ferruginous, more or less mingled with darker.

*Legs*.—Coxae, trochanters, and the greater part of the femora black; the outer ends of the femora, the tibiae, and the tarsi, except the last segment, yellow ferruginous; last tarsal segment and claws dark or black; spines yellow ferruginous; coxae, trochanters, and femora slightly sericeous in places and with short, scattered hairs.

*Length*.—Females, 22–25 mm.

The specimens of this species which I have seen were taken, one June 20, 1883, at New Orleans, Louisiana; one in Georgia; one had no data, and the others were taken August 23, 1902, at Indian Head, Maryland, on the flowers of *Monarda punctata* Linnæus.

This insect is easily confused with females of *Chlorion flavitarsis*, but may be separated from it by the almost or entire absence of pubescence and of any short vein entering the median cell of the hind wing from the cubital vein just beyond the junction of the latter with the discoidal vein, both of these characters being present in *C. flavitarsis* and absent in *C. bridwelli*.

## CHLORION (PROTEROSPHEX) RESINIPES, new name.

||*Sphex rufipes* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 343.

Medium sized insects; the head, thorax and petiole black; abdomen, legs (except the coxæ) and tegulæ deep ferruginous or resin colored; wings hyaline with a yellow tinge, but also somewhat fuliginous with a violet reflection.

*Female*.—Head broad but hardly quadrangular, the cheeks retreating too quickly, though the eyes are quite full; clypeus black, its anterior margin and a median extension backward therefrom being more or less ferruginous; rather sparsely covered with yellowish-white pubescence and numerous long, yellowish hairs, the outer ends of which are blackish; the anterior margin of the clypeus somewhat reflexed, the portion beneath the eyes bare, smooth; the front margin quite evenly rounded, with two small, rounded lobes at the middle just above which is a slight depression or fovea; frons pubescent like the clypeus nearly to the ocelli, and with whitish hairs, shorter than those on the clypeus; this plate above the pubescence, the vertex, occiput and cheeks, black, somewhat sericeous; distance between the lateral ocelli less than from them to the eyes; vertex and occiput with fairly numerous, long, whitish hairs and a few longer, black ones; cheeks with a small, whitish, sparsely pubescent area behind the middle of the eye, becoming merely whitish-sericeous above and below; with numerous whitish and yellowish hairs, closer together and longer below; the cheeks broadest about one-third of their length below the top of the head; narrowing rapidly below, about two-thirds the width of the eye at their widest point; antennæ black, the scape ferruginous beneath, with a few short, pale hairs; outer part of the filament somewhat sericeous; relative lengths of the filament segments  $\frac{30}{30} \frac{1}{33}$ ,  $\frac{2}{19}$ ,  $\frac{3}{19}$ ,  $\frac{4}{19}$ ; mandibles rather stout, each not quite reaching to the base of the other, two-toothed, the teeth black nearly to their bases, the remainder ferruginous with a blackish tinge at the basal articulation; the anterior face with a number of irregular punctures, the inner edge with a few long, ferruginous and black hairs, and the outer edge with a sparse fringe of similar ones.

*Thorax*.—Anterior face of the collar rising sharply about at right angles to the neck, partly whitish sericeous and with quite long, whitish hairs; the dorsal edge silvery pubescent, only very slightly flattened in the middle; the posterior face closely appressed against the mesonotum; the side in front of the prothoracic lobe quite smooth, somewhat glistening; prothoracic lobe bare in front, rather sparsely pale yellowish-white pubescent behind and with its hinder margin densely fringed with short, dirty yellow hairs; lateral suture of the neck fringed with very short, gray hairs; mesonotum with a white-pubescent, rather narrow band, beginning above and slightly behind the front



edge of the tegula on each side and running backward, then bending inward on the posterior margin to meet the band from the other side; at some angles this band is lost to sight except for a spot above the tegula; the rest of the plate closely, rather coarsely punctured and with many very short, erect, dirty white hairs; the anterior median groove rather broad and flat, its edges rather sharper behind, the groove faint in front, fading into the general surface of the plate behind, about one-third the length of the plate; scutellum slightly sericeous, with a very slight median groove behind, more sparsely and finely punctured than the mesonotum, with many very short, erect, whitish hairs; postscutellum silvery pubescent as far toward the sides as the groove at the side of the dorsum of the median segment, bearing numerous very short, erect, white hairs; dorsum of the median segment finely transversely aciculate in front, rather obliquely so behind, somewhat arched along the middle line except behind, where it is slightly hollowed; quite thickly covered with short, erect, whitish hairs; fovea a rather shallow, elongated crescent; posterior end of the median segment making quite an angle with the dorsum, but less than a right angle; with sparse silvery pubescence on each side of the middle which is not concealed and shows scattered, rather fine elevations; sides above with aciculations continued from the dorsum, becoming lost below, where the surface is roughened by scattered, small elevations, this condition extending down to the stigmal groove; the end and sides of the median segment rather sparsely covered with long, white hairs; mesopleura with a small, silvery pubescent spot behind and a little below the prothoracic lobe; the remainder black, with fine, rather close punctures above, becoming coarser below; mesosternum and the lower part of the mesopleura whitish sericeous, almost pubescent and with many long, white hairs, which are also present in less numbers above; metapleura with a sparse and sometimes interrupted band of silvery pubescence along the stigmal groove, and a spot of similar pubescence on the metapleural lobe just beneath the base of the hind wing, the rest of the plate being black, sparsely, finely punctured, and with long, whitish hairs, more abundant at and near the pubescent areas; from the hind coxæ to the middle pair on the side is a whitish-sericeous, broad band; petiole black, straight, with short, whitish hairs and a trace of whitish sericeous in some lights; its length compared with that of the second hind tarsal and first filament segments—22:28: (30 to 33).

*Abdomen*.—Deep ferruginous or resin color, varied with somewhat darker, glistening, rather pointed at both ends; first dorsal plate not rising very abruptly or very high from the petiole, slightly yellowish-sericeous; the surface of the dorsal plates with scattered punctures, larger and more abundant posteriorly, the last two plates very noticeably so and bearing short, ferruginous hairs, longer on the last plate;

next to the last plate very slightly emarginate behind; terminal plate with its hinder margin broadly acuminate, the tip itself rounded, and with a faint median ridge extending forward a short distance. Beneath slightly paler than above, with rather coarser and more generally distributed punctures, and a few scattered hairs, most abundant on the last two plates; the last plate rather broad and evenly rounded behind, possibly very slightly emarginate at the middle.

*Wings.*—Hyaline, tinged with yellowish, the outer margins somewhat fuliginous, particularly beyond the end of the radial cell; everywhere with a violet reflection; the veins ferruginous-brown to brown. Fore wing with the first recurrent vein joining the second cubital cell about two-thirds of the distance from the first to the second transverse cubital veins; the second and third transverse cubital veins about half the distance apart on the radial vein that the second transverse cubital and second recurrent veins are on the cubital vein; transverse median vein of the hind wing almost straight, making about a right angle with the median vein; discoidal vein nearly or quite interstitial; the cubital vein bending slightly forward before running outward, joining the transverse cubital quite obliquely and becoming obsolete beyond that point; tegulae ferruginous, darker behind, with a slight yellow or golden pubescent spot near the middle.

*Legs.*—Coxae and more or less of the bases of the trochanters black, also the tips, inner edges and teeth of the claws; the remainder of the legs reddish ferruginous, as are the hairs and spines; fore femora somewhat hairy, particularly beneath; fore tibiae coarsely yellowish sericeous in front; fore metatarsi with nine long comb teeth, the first one about half the length of the others, alternating with short spines; inner contour of hind tibia straight; its hind surface coarsely yellow sericeous; tarsi of all the legs more or less yellowish sericeous.

*Length.*—Females, 21–23 mm.

*Males.*—Unknown.

I have seen about a dozen specimens of this striking species in the collection of the American Entomological Society, all females, and all from Costa Rica, Cuba, and Santo Domingo. As they agree with Lepeletier's description and come from the same region there seems to be little room to doubt their identity and we may consider Lepeletier's species as having now been rediscovered. Unfortunately the name selected by that author was preoccupied, so it has been necessary to assign it a new name. The rich color of the abdomen and legs, somewhat resembling that of *Chlorion ichneumoneum fulviventris*, but richer, contrasting with its silvery pubescence, makes this an extremely beautiful species.

**CHLORION (PROTEROSPHEX) ASHMEADI**, new species.

*Type*.—Described from six female and five male cotypes. Three male and four female cotypes are now in the collection of the American Entomological Society; one male and one female are in the collection of the U. S. National Museum (Type, Cat. No. 9858, U.S.N.M.), and the remaining male and female are in the collection of the Massachusetts Agricultural College.

Medium-sized insects with black head and thorax; abdomen pale ferruginous to yellowish; petiole black or ferruginous; legs, except the coxæ, trochanters and tips of the claws ferruginous yellow; wings hyaline, with a yellow tinge in the females, rather fuliginous in the males; pubescence pale golden to silvery, mainly the latter.

*Female*.—Head rather broad (not as broad as the distance between the outer margins of the tegulæ), rather oval in outline when viewed from above; clypeus slightly arched, with scattered punctures and sparse pale golden to silvery pubescence, which extends upward on the frons to above the antennæ; the anterior margin of the clypeus quite evenly rounded across the front, with no teeth or irregularities, but sometimes faintly tinged with ferruginous; the surface well provided with long black hairs; frons sparsely punctured above the pubescence and bearing numerous black hairs, shorter and smaller than those on the clypeus; vertex minutely punctured, with a transverse crest between the posterior margins of the eyes; the vertex and cheeks faintly sericeous in certain lights; cheeks retreating quite sharply, not more than half the width of the eyes, sparsely, minutely punctured above, more thickly punctured below, where there are numerous long, black hairs; inner margins of the eyes parallel; antennæ black, the scape more or less dull ferruginous beneath, minutely punctured; relative lengths of the filament segments  $\frac{1}{30}$ ,  $\frac{2}{20}$ ,  $\frac{3}{18}$ ,  $\frac{4}{18}$ ; mandibles two-toothed, ferruginous except from the bases of the teeth to their tips, where they are black; somewhat aciculated in front and beneath on the ferruginous portion; with a few long, pale ferruginous hairs near the base of the inner border, pointing toward the anterior tooth, and a fringe of similarly colored hairs on the outer border pointing backward.

*Thorax*.—Black, without pubescence; anterior face of the collar not rising very sharply from the neck, somewhat rounded laterally, its surface with fine scattered punctures and black hairs; the dorsal edge rather flattened near the middle line; the posterior face not closely appressed against the mesonotum, nearly vertical; side of the collar in front of the prothoracic lobe smooth, glistening; prothoracic lobe black, glistening, moderately punctured, with numerous black hairs of medium length and a dense fringe of pale brown, short hairs on the posterior margin; mesonotum quite closely, rather weakly punctured,

with short, black hairs and here and there a trace of silvery sericeous; its lateral and posterior margins from the prothoracic lobe to where the scutellum reaches the height of the mesonotum behind, somewhat reflexed; anterior median groove slight, broad; scutellum less closely punctured, glistening, with a slight median groove, particularly behind; somewhat whitish-sericeous; postscutellum rather more closely punctured; with a very slight median groove and with a few short hairs; median segment everywhere dull black; finely, closely punctured; thickly covered with short, whitish hairs, which at the sides and behind become much longer and brownish in part; petiole pale, almost yellow ferruginous, short, straight, with numerous pale yellowish hairs; its length compared with that of the second hind tarsal segment and first filament segment, 30: 35: 35; meso and metapleura finely, not densely, punctured and with numerous black hairs of varying length; that portion of the mesopleuron nearest the base of the fore wing is sometimes dull ferruginous; at different places on the pleura are silvery sericeous areas, visible only at certain angles; sterna with the same type of punctures, hairs and sericeous areas as the pleura.

*Abdomen*.—Pale yellowish ferruginous, except for a few dark spots varying in form and location in different specimens or absent in some cases; rather long, pointed behind, rather broad in front; the surface above pale sericeous, smooth except for small punctures, few anteriorly where they are at the sides, but increasing posteriorly and encroaching more on the dorsal region; they are first very noticeable on the fourth plate, become coarser and more abundant on the fifth, and are very prominent on the terminal plate where are also a few pale yellow hairs pointing backward; the hinder margin of this plate is broadly rounded, with a slight blunt median projection; beneath the color is the same as above, sometimes with irregular darker markings here and there; there are a few scattered coarse punctures on each plate, chiefly a little lateral to the median line, and occasional quite long pale yellowish hairs.

*Wings*.—Hyaline, with a strong yellow tinge, particularly toward the base; faintly fuliginous on the outer border; second and third transverse cubital veins of the fore wing about half as far apart on the radial as on the cubital vein; transverse median vein of the hind wing straight, joining the median at more than a right angle; cubital vein well developed beyond the transverse cubital; tegulae yellow, glistening, with a few scattered slight punctures.

*Legs*.—Coxae and trochanters black, the latter with a reddish brown tinge, with scattered punctures and short dark hairs; the coxae showing a tendency to be sericeous in places; the other segments of all the legs ferruginous yellow, as are their spines; inner edges of the claws, their tips and teeth, black; posterior tibiae yellow sericeous behind, their inner contour straight; fore metatarsal comb with ten (some-



times eleven) comb teeth, the last one or two very stout; their length about half that of the metatarsus.

*Male*.—Differs as follows: The scape is less evidently ferruginous beneath; traces of silvery pubescence are present on the end of the median segment above the petiole; mesopleuron at the base of the fore wing black; petiole black, sometimes faintly tinged with ferruginous; abdomen quite whitish-sericeous, this increasing posteriorly and being very pronounced and coarse on the last three segments; posterior margin of the last dorsal plate evenly rounded; clypeus with a slight depression on the median line anterior to the middle; seventh ventral abdominal plate slightly, broadly emarginate, the eighth less broadly but more deeply so; the terminal plate quite strongly rounded at the sides, acuminate in the middle behind and with a slight ridge along the middle; wings quite uniformly fuliginous and with a slight violet reflection, but still with a yellowish tinge in some cases; femora partly—the posterior pair mostly—black; the last tarsal segments generally darker than the others, the tips of which are their darkest portions.

*Variations*.—In some specimens variations from these characters have been observed. In one case the pubescence on the clypeus and frons was golden below, becoming silvery above, and it extended well above the antennæ; the anterior face of the collar was strongly sericeous; the scape was nearly all ferruginous; traces of a lateral mesonotal pubescent band, silvery white in color were seen; the dorsum of the median segment was closely covered with short dull yellow erect hairs and the posterior end of the segment was dull yellow pubescent; the hinder part of the prothoracic lobe, a vertical streak behind it and a spot or streak above the middle coxæ were yellowish-white pubescent. One female had a black petiole, the last three abdominal segments black and the others so dark as to seem dark reddish brown. Other specimens show one or another of these variations.

*Length*.—Females, 21–27 mm.; males, 19–25 mm.

This species appears to have a somewhat restricted habitat. The specimens seen all came from Texas, New Mexico, Arizona, and Colorado, the records being: "Tex.;" "Col.;" Florence, Arizona, August 23, 1902, and April 20, 1903; Congress Junction (July), and Bill Williams Fork (August), Arizona; Las Cruces, New Mexico; Alamogordo, New Mexico (VI, 7, '02); and Yuma County, Arizona, September, 1903.

In some respects this species resembles *Chlorion ruficaudum* (Dahlbom), but differs from it in not having its tibiæ enlarged near the end, and in having partly yellow legs and in the practical absence of pubescence.

## CHLORION (PROTEROSPHEX) SPINIGER (Kohl).

? *Sphex dorsalis* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 347, male.

*Sphex habena* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 211 (misidentification).

? *Sphex singularis* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 33, pl. III, figs. 7, 7a.

*Sphex spiniger* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 428.

Rather small insects; body black, sometimes with more or less ferruginous; legs the same; pubescence silvery to golden; hairs yellowish to gray.

*Female*.—Unknown; see remarks below, and after *Chlorion dubitatum*.

*Male*.—Head black, rather broad; clypeus and frons to above the antennae covered with golden pubescence and long, golden hairs; anterior margin of the clypeus rather truncate, without teeth or projections; vertex and cheeks with numerous long, pale golden hairs; distance between the lateral ocelli greater than from them to the eyes; cheeks about half the width of the eyes, with traces of golden or paler pubescence below; inner margins of the eyes somewhat converging downward; antennae black, the scape quite thickly clothed within and below with short, yellow hairs and with a trace of pubescence; the first segment of the filament longest; mandibles black, very faintly ferruginous near the bases of the teeth, rather slender, somewhat aciculated beneath, and with a few yellowish hairs on the posterior face.

*Thorax*.—Collar sparsely covered with whitish hairs, silvery pubescent on its dorsal edge and with traces of pubescence at the side below; not closely appressed against the mesonotum; its front and rear faces nearly vertical; with a slight but noticeable median depressed line in front; prothoracic lobe with scattered punctures anteriorly; with pale yellowish, almost silvery pubescence posteriorly; mesonotum with a pale yellow or whitish pubescent band on each side, beginning about opposite the anterior edge of the tegula and running backward along the margin of the plate to its posterior end, then turning inward but not usually meeting the band from the other side; the rest of the mesonotum closely, rather minutely, punctured; the anterior median groove rather deep; the entire plate quite thickly covered with pale yellowish hairs not as long as those of the head but obscuring the pubescence; scutellum black, with numerous fine punctures, a slight median groove, and covered with yellowish-white hairs, shorter and less noticeable than those of the mesonotum; postscutellum covered with silvery pubescence and long hairs; median segment thickly clothed with pale yellowish hairs, shortest on the dorsum, which is faintly rugose in places, almost irregularly transversely aciculate; the dorsum has a very slight depression anterior to the fovea; posterior end of the median segment with a pair of silvery pubescent spots, confluent on the middle line, the surface between these and the stigmal groove

roughened by the presence of many small elevations; meso- and metapleura with long, yellowish-white hairs; a spot behind the prothoracic lobe is pale yellowish pubescent, and there is a silvery pubescent band on the metapleuron from the hind coxæ along the stigmal groove; the general surface of the mesopleuron is rather roughened; mesosternum quite thickly covered with long, yellowish hairs and sometimes partly pale yellowish pubescent; petiole short, straight, black, quite thickly clothed with long, pale yellow hairs, and with traces of yellowish sericeous in some cases.

*Abdomen*.—Black, sometimes more or less ferruginous; yellowish sericeous, particularly anteriorly; above, the last four plates bear short, dull yellow hairs pointing backward, most abundant at the sides in front, but everywhere on the last plate; posterior margin of the last plate rounded, with a slight notch or only an emargination in the middle; beneath glistening, smooth, with a few scattered hairs, particularly at the sides, on the hinder plates; posterior margin of the seventh plate forming a deep, broad notch, with a tuft of dark yellowish hairs on each posterior angle and a short, nearly erect, sharp-pointed spine in the middle near the base of the segment, often concealed by the sixth plate, which may cover it from sight; terminal plate triangular, rather narrow at the base, forming a point behind, from which a pronounced ridge runs forward in the middle of the plate to its base.

*Wings*.—Hyaline, slightly fuliginous along their outer margins or rarely somewhat fuliginous everywhere; with a noticeable darker shade beyond the end of the radial cell; cubital vein of the fore wing obsolete beyond the end of the third cubital cell; transverse median vein of the hind wing quite straight, making more than a right angle with the median; discoidal vein not interstitial; cubital vein with a noticeable backward bend near its middle, obsolete beyond the transverse cubital vein; the radial runs but a short distance beyond this point also; tegulæ black with a ferruginous tinge behind, very faintly sericeous in front, quite smooth.

*Legs*.—Black, sometimes more or less ferruginous, the distribution of the color being irregular; anterior coxæ yellowish pubescent in front; all the coxæ thickly covered with long, yellowish hair, thickest and longest on the front pair; trochanters black, with more or less of yellowish hairs; anterior and middle femora quite hairy, the posterior pair smooth; tibiæ and tarsi yellowish sericeous, the spines on the anterior and middle pairs yellow, those on the posterior pair all or in part black; claws black.

*Variations*.—Differences in the amount of ferruginous on the abdomen and legs, and in the depth of color of the pubescence and hairs give to different specimens of this species quite different general appear-

ances, particularly when examples from the southern United States and from the West Indies are compared.

*Length*.—Males, 17–20 mm.

It is possible that this insect may prove to be the *Sphex dorsalis* of Lepeletier, but if so Lepeletier's description must have been made from one of the more ferruginous specimens. Several collections in this country have examples of *C. spiniger* labeled *Sphex habena* Say. This error is due to the misidentification of the specimens by Cresson. Cameron's description of *Sphex singularis* may perhaps be of this insect, but the absence of some points from his description prevent any positive conclusions being reached.

I have studied examples of *Chlorion spiniger* from Florida, Louisiana, Mississippi, Texas, Santo Domingo, Barbados, Dominica, and Trinidad. Kohl records it from Mexico and Brazil. In quite a large lot of specimens of *Chlorion* from the above-named West Indian Islands all the males were *spiniger* and all the females *dubitatum* which is rather suggestive of a relation between these species and which is considered under *dubitatum*.

#### CHLORION (PROTEROSPHEX) DUBITATUM (Cresson).

|| *Sphex dorsalis* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 259.

|| *Sphex micans* TASCHENBERG, Zeits. f. d. ges. Naturw., XXXIV, 1869, p. 419.

*Sphex dubitata* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 213.

*Sphex ichneumonea* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 34.

*Sphex ichneumoneus* var. *dorsalis* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 431.

*Sphex dubitatus* Fox, Proc. Acad. Nat. Sci. Phila., 1897, p. 377.

*Type*.—Cresson described *Sphex dubitata* from three females in the Belfrage collection. In the collection of the American Entomological Society are three specimens marked "Type," one of which bears the following label in Cresson's handwriting:

|                                                                                                  |
|--------------------------------------------------------------------------------------------------|
| <p>S. = ich. var <i>dorsalis</i><br/> <i>dubitata</i><br/> Cr.<br/> ♀ of <i>habena</i>? Say.</p> |
|--------------------------------------------------------------------------------------------------|

In the National Museum is a female marked "Texas Belfrage. Type No. 1686." Which one of these four is not entitled to cotype value I am unable to say.

Rather small, slender insects; body, to and including the petiole, black; abdomen black and ferruginous, as are the legs; wings generally quite hyaline, sometimes more or less fuliginous; pubescence golden to silvery.

*Female*. Head quite broad; clypeus and frons pale golden pubescent nearly to the level of the ocelli and with numerous long hairs of the same color; anterior margin of the frons evenly rounded, with two



short, blunt lobes at the middle, separated by a slight notch; head above the pubescence sparsely, rather finely punctured and bearing long, slender hairs; behind the ocelli is a slightly elevated, transverse-oval, velvety area; occiput and cheeks minutely, closely punctured and with long, yellowish hairs; cheeks pale golden pubescent close behind the eyes, beginning just below the top of each eye; with long, pale yellow hairs more abundant below; inner margins of the eyes very slightly converging downward; antennae black; scape strongly sericeous, almost pubescent, with numerous short, pale yellow hairs on its upper and inner sides; first segment of the filament longest; the entire filament slightly sericeous in certain lights; mandibles black with a faint ferruginous tinge; with longitudinal striae on the basal part of the under surface, a few long, yellow hairs on the inner edge, and a fringe of similar hairs on the posterior face.

*Thorax*.—Collar covered everywhere above with pale yellow, almost silvery pubescence, least dense near the middle line; with numerous long, pale yellow hairs; posterior surface not closely appressed against the mesonotum, it and the anterior face nearly vertical; the dorsal edge rather flattened above; the sides bare; prothoracic lobe with pale yellow pubescence behind; mesonotum with a yellow pubescent band at the side, extending backward from in front of the tegula till it barely meets the corresponding band of the other side on the median line behind; the rest of the plate closely punctured and covered with short, pale yellow hairs; anterior median groove faint; scutellum with a median depression, strongest behind, minutely punctured; post-scutellum pale yellow, almost silvery pubescent to the groove at the side of the dorsum of the median segment but showing a median depression; dorsum of the median segment sparsely pale yellow, almost silvery pubescent and with quite a dense covering of rather short, pale yellow hairs; posterior end of the segment with two yellowish-silvery pubescent spots, confluent on the middle line, their dorsal portions extending a short distance along the suture from the fovea to the stigma; the area between this pubescence and the stigmal groove black, roughened, particularly below; the end and sides of the median segment thickly clothed with long, pale yellow hairs; mesopleuron with a large, pale yellow pubescent spot just behind the prothoracic lobe; a rather broad, silvery strip of pubescence runs from above the hind coxa along the stigmal groove to the stigma, then toward the base of the hind wing, becoming broader and with long, yellowish hairs, making this portion more yellow; petiole short, straight, black, yellowish-white sericeous and bearing quite long, pale yellow hairs.

*Abdomen*.—Not as long as the thorax, elongate-oval, quite pointed at both ends; above, ferruginous except for a narrow cross band of dark color just behind the petiole (not always present) and a cross

band of black on the third, fourth, and fifth plates, not usually covering all the surface of these plates; the ferruginous portions of the dorsal plates are somewhat varied in their depth of color; all the plates are sericeous; beneath, with a similar black band on the third, fourth, and fifth plates; there are a few punctures on the last three dorsal plates, being few in number and weak on the first two, and chiefly at the sides, but quite large and generally distributed on the terminal plate which bears a few brownish hairs; the surface beneath is glistening, with minute punctures and scattered hairs, the former becoming more abundant posteriorly.

*Wings.*—Yellowish hyaline, somewhat fuliginous on the outer margins, in some cases quite generally fuliginous; first and second transverse cubital veins close together on the radial cell in the fore wing, and the first recurrent vein almost interstitial with the second transverse cubital vein; tegulae dark, nearly black, somewhat sericeous or almost pubescent near the middle.

*Legs.*—Coxae black, the posterior pair silvery pubescent behind; all with numerous pale and dark yellowish hairs and rather sericeous; trochanters black, sericeous; the other segments ferruginous except the bases of the femora, the last one or two tarsal segments and the claws, the tarsal segments being brown, and the claws black tipped; fore metatarsus with nine comb teeth, shorter than half the length of the metatarsus; inner contour of the hind tibia straight, its posterior surface densely pale sericeous.

*Variations.*—Some one or more of the following variations often occur: The black on the first dorsal abdominal plate is sometimes absent; the terminal dorsal plate may be dark but not black; the black on the third, fourth, and fifth segments is not always continuous; and there is sometimes a tiny pubescent spot above the middle coxae.

*Length.*—Females, 17–22 mm.

I have seen specimens of this species from Florida, Mississippi, Texas (Columbus), and Mexico. Fox reports it from Brazil. I am unable to distinguish *dubitatum* from what has been known as *Sphex dorsalis* Smith, regarded by Kohl as a variety of *Chlorion ichneumonenum*, and a long series of comparative measurements fails to show any differences. The only distinctions which are perceptible seem to be in the color of the pubescence, that of *dubitatum* being paler. In many cases, however, every gradation of shade between the two can be found, and certain other characters which are common to the two do not seem to occur in other species.

Kohl regards *micans* or *dorsalis* Smith as a variety of *ichneumonenum*. With this I am not prepared to agree, as *micans* is a more slender insect in proportion to its length, has black mandibles with at most only a faint ferruginous tinge, the scape is black, the anal segment is ferruginous, the teeth of the fore metatarsal comb are less than half

the metatarsus in length, meso- and metapleural pubescent spots are usually entirely absent and when present are very slight, and the pubescence generally averages paler than in *ichneumonenum*, though in southern specimens there may be little difference in this regard. As *micans* is preoccupied, however, *dubitatum* Cresson is the name which must be applied to this species.

Accepting *dubitatum* as a good species we find that all the specimens are females. A closely related species is *spiniger*, of which only males are known, found in the same territory, and in quite a collection of these insects from the West Indies which I have studied, every female was *dubitatum* and every male was *spiniger*. Taking these facts into consideration, I am of the opinion that these species will ultimately prove to be identical, and not a subspecies of *ichneumonenum*, but a valid species.

CHLORION (PROTEROSPHEX) MAXIMILIANI (Kohl).

*Sphex maximiliani* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 429.

Medium sized, rather robust insects; head and thorax black; abdomen and legs black and ferruginous, the amount and distribution varying; pubescence golden to pale; quite hairy, the hairs being golden or paler; wings quite hyaline, somewhat tinged with yellowish near the base, rather fuliginous on the outer margins.

*Female*.—Not seen by me. Notes on differences from the male, taken from Kohl's description, are given below.

*Male*.—Head rather large; clypeus and frons to above the antennæ covered with golden pubescence and numerous long golden hairs; anterior margin of the clypeus black, somewhat emarginate; frons scatteringly, rather coarsely punctured above, with long yellow hairs; vertex and cheeks rather more closely punctured, covered with long yellow hairs, particularly long and dense on the lower part of the cheeks where there is also some golden pubescence; cheeks about half the width of the eyes; inner margins of the eyes slightly converging downward; antennæ black except the scape which is tinged with dark ferruginous below and bears numerous dull yellow hairs on its lower and inner sides; first segment of the filament longest, slightly larger toward its tip; mandibles two-toothed, black except for a pale yellowish ferruginous band at the base of the teeth, slightly punctured below, and with a partial fringe of short yellow hairs on the lower margin.

*Thorax*.—Covered everywhere except on the scutellum with quite long yellowish hair; collar with its anterior and posterior faces nearly vertical, the latter not closely appressed against the mesonotum; dorsal edge of the collar evenly rounded, highest in the middle, covered with yellow (sometimes pale) pubescence; the hairs so thickly cover the surface as to conceal all markings; prothoracic lobe with a narrow,

yellow pubescent band on the posterior margin; mesonotum with a narrow, much obscured, golden pubescent band on the side, beginning in front of the tegula and running backward on the margin of the plate, then inward on its posterior margin till it nearly or quite meets the band of the opposite side; the remainder of the surface of the plate quite closely, rather coarsely punctured and with a slight anterior median groove, extending hardly one-third of the length of the plate; scutellum with fewer, shorter hairs than the other parts of the thorax; its surface with rather more scattered punctures than the mesonotum, with a slight median groove, more pronounced behind; postscutellum obscurely golden pubescent, with a dense covering of long yellow hairs rather paler than those on the median segment; median segment everywhere covered with long yellow hairs, particularly long behind, where there are no pubescent spots; the dorsum finely, transversely aciculate; sides between the stigmatal groove and the petiole roughened; meso- and metapleura covered nearly everywhere with quite a thick covering of long yellow hairs; no pubescent band along the stigmatal groove; petiole short, straight, black, quite thickly covered with long pale-yellow hairs.

*Abdomen*.—Above, somewhat sericeous anteriorly; more or less of the first two dorsal plates ferruginous mingled with black, the other plates black; the last three plates with short, yellow, backwardly projecting hairs, few and at the sides on the anterior one, more abundant and extending toward the middle on the next, and generally distributed over the surface of the last; these plates also have correspondingly distributed punctures; beneath, the first two plates ferruginous mingled with black, the other plates black; all the plates have scattered punctures, chiefly at the sides, and a few rather long yellow hairs; the fifth, sixth, and seventh ventral plates are emarginate behind, the emargination being greater on the hinder plates and on the seventh almost becoming a notch; these three plates also bear numerous yellow hairs at the sides, almost forming tufts, much as in *C. ichneumoncum*; terminal plate like that of the last-named species.

*Wings*.—Quite hyaline, somewhat yellowish near the base and rather fuliginous on the outer margins; the venation as in *C. ichneumoncum*; tegulae almost black, but with a brownish tinge, a little lighter on the outer border; faintly sericeous.

*Legs*.—Coxae and trochanters black, more or less hairy; fore femora with numerous yellow hairs, ferruginous near the base and tip, elsewhere black; fore tibiae ferruginous, sericeous; fore tarsi ferruginous, sericeous above, the last segment and the claws darker, the claw tips black; middle femora ferruginous at base and tip, with a few yellow hairs, chiefly below; middle tibiae and tarsi ferruginous, somewhat sericeous above, the last tarsal segment and the claws darker, tips of the claws black; hind femora black except near the tip, with-



out hairs; hind tibiae ferruginous except for a black stripe above: sericeous, especially behind; tarsi dull ferruginous, lighter at the tip of the metatarsus and of the next segment (sometimes the whole of these two segments); last three tarsal segments at least, darker; the tips of the claws black; spines on all the legs ferruginous; inner contour of the hind tibia straight.

*Female*.—Differing from the foregoing, according to Kohl's description, as follows: hind tibia without the black stripe above: there seems to be pubescence on the hinder end of the median segment in both sexes according to Kohl, but I have not found it in the males described above: inner margins of the eyes parallel: fore metatarsus with nine comb teeth; abdominal structures of the last few segments differing, of course.

*Length*.—Females, "22–24 mm." (Kohl); males, 15–24 mm.

I have seen three specimens of this species captured in Mexico (no closer data). Kohl thinks that it may be a variation of *Chlorion ichneumoneum*, and this may be correct, though I am inclined to doubt it.

#### CHLORION (PROTEROSPHEX) ICHNEUMONEUM (Linnæus).

*Apis ichneumonea* LINNÆUS, Syst. Nat., 10th ed., I, 1758, p. 578.

*Vespa jamaicensis* DRURY, Ill. Exot. Ins., I, 1770, p. 104, pl. XLIV, fig. 4.

*Sphex ichneumonea* FABRICIUS, Syst. Ent., 1775, p. 348.

? *Sphex ornata* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 314.

*Sphex ichneumonea* WALSH and RILEY, Am. Ent., I, 1869, p. 127.

*Sphex ichneumonea* PACKARD, Guide to Study of Ins., 2d ed., 1870, p. 167.

*Sphex ichneumonea* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 213.

*Sphex ichneumonea* RILEY, 1st Rept. U. S. Ent. Com., 1878, p. 318.

*Sphex ichneumonea* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 382.

*Sphex ichneumonea* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 34, pl. III, figs. 8, 8a.

*Sphex ichneumonea* PROVANCHER, Addit. Faun. Can. Hym., II, 1889, p. 257.

*Sphex ichneumoneus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 430.

*Sphex ichneumonea* ASHMEAD, Psyche, VII, 1894, p. 64.

*Sphex ichneumoneus* FOX, Proc. Acad. Nat. Sci. Phila., 1897, p. 377.

*Sphex ichneumonea* PECKHAMS, Wise. Geol. and Nat. Hist. Surv., Bull. 2, 1898, p. 33, pl. II, fig. 4; pl. XI, fig. 1; pl. XII, figs. 1, 2.

*Sphex ichneumoneus* DUCKE, Zeits. f. Syst. Hym. u. Dipt., I, 1901, p. 242.

*Sphex ichneumonea* PECKHAMS, Wasps, Social and Solitary, 1905, p. 56.

Rather robust insects, of medium size; head, thorax, petiole, and bases of the legs black; abdomen black and ferruginous; legs mainly ferruginous; wings nearly hyaline to quite fuliginous; pubescence golden or a little paler; hairs golden to pale straw.

*Female*.—Head rather large, quadrangular when viewed from above, the cheeks being quite wide; clypeus somewhat arched laterally, all but its anterior margin thickly covered with golden pubescence and numerous long golden hairs; the pubescence may be thin or absent along the median line anteriorly; anterior margin somewhat reflexed, rounded, with a pair of short, blunt, projecting lobes at the middle, separated

by a slight notch and sometimes with a slight notch lateral to each; the reflexed margin with a tendency to ferruginous; pubescence continued upward from the clypeus over the frons to above the antennæ, sometimes nearly to the ocelli, mixed with golden hairs averaging a little shorter than on the clypeus; frons and vertex with scattered, minute punctures; occiput minutely punctured, bearing dark and yellow hairs about as long as those on the frons; a transverse-oval area just behind the ocelli is rather velvety black; cheeks nearly as wide as the eyes, with a golden pubescent band close behind the eyes, not reaching their tops, and variable in width and amount; with very long yellow hairs, most abundant low down; inner margins of the eyes parallel; scape of the antennæ ferruginous, either entirely or with more or less black above, with short yellowish hairs, particularly on the inner side; pedicel short, black, sometimes slightly ferruginous beneath; filament black, its first segment much the longest; mandibles large, stout, two-toothed, the teeth black to their bases, the remainder of the mandible ferruginous, with a few long light-colored hairs on the inner margin, pointing toward the anterior tooth; outer margin with scattered light-colored hairs; anterior face with a few elongated indentations on the ferruginous portion.

*Thorax*.—Anterior face of the collar rising nearly at right angles to the neck, rather flattened from side to side, golden pubescent, least so in the middle; dorsal edge evenly rounded from side to side, golden pubescent, the edge and the anterior face bearing long, golden hairs; posterior face not closely appressed against the mesonotum; side in front of the prothoracic lobe black, glistening, though with many hairs; the prothoracic lobe black in front, golden pubescent behind, and bearing long, golden hairs; mesonotum black, with a band of golden pubescence on each side extending from the prothoracic lobe upward, then backward, then inward on the posterior margin of the plate, where it is narrower, till it meets the band from the opposite side; lateral margins of the plate slightly reflexed; remainder of the plate black, coarsely, closely punctured, and with many short, yellow hairs; with a slight anterior median groove extending about one-third of the length of the plate; the surface of the plate is sometimes so thickly covered with hairs as to partly conceal the pubescent bands and give the whole area a dull brownish yellow appearance; scutellum black, somewhat arched, with a median longitudinal groove, more marked behind, finely, sparsely punctured and almost devoid of hairs, except when the insect is unusually hairy; postscutellum with a median longitudinal groove; golden pubescent as far laterally as the lateral suture of the dorsum of the median segment; median segment black, covered above and behind with golden pubescence, not generally so dense above as to conceal the surface, which is minutely, transversely aciculate; from the fovea to the petiole the pubescence is very thick,

its margin following the outer edge of the dorsum about half way from the fovea to the stigma, then obliquely backward to the lower part of the side of the petiole, thus leaving a black strip between it and the stigmatal groove; the entire dorsum, sides and end of the median segment bearing thickly set, long, yellow hairs, longer behind; these hairs are sometimes quite pale, giving a dull yellow color to this portion of the body; prosternum golden sericeous in front of the anterior coxæ, and with long, yellow hairs; mesopleuron with an irregularly vertical band of golden pubescence just behind the prothoracic lobe, which bends forward above toward the front end of the mesonotal band; metapleural lobe golden pubescent, as is also a spot just above and in front of the mesocoxa; above the hind coxa, below the stigmatal groove, is a similar, more elongated spot, more or less continuous, with a pubescent band extending downward along the groove (often on both sides of it) from the stigma and forward to the anterior end of the median segment; petiole short, straight, black, about two-thirds as long as the second hind tarsal segment or the first segment of the filament; with numerous short, yellow hairs and a tendency toward pubescence.

*Abdomen.*—First two segments black, the third more or less so; the remainder black; above, sericeous, more noticeable anteriorly, smooth, more or less varied with darker; last four segments punctured, the first very faintly and sparsely, the punctures becoming more pronounced and closer on the more posterior plates; there is a median, triangular area on each of these plates except the last, not encroached upon by the punctures; the last three plates bear a few brownish hairs, chiefly at the sides, and quite long on the last two; beneath, colored as above; surface glistening, not sericeous, the plates with scattered, rather coarse punctures and scattered ferruginous hairs, almost entirely lacking along the median line except on the terminal plate; the hairs show a tendency to form a row on each plate parallel to and a little in front of the posterior margin, except on the last plate.

*Wings.*—Yellowish hyaline, particularly toward the base, becoming fuliginous on the outer borders; in some cases the fuliginous is strong and quite generally distributed, and then there is a violet reflection; second and third transverse cubital veins of the fore wing not near each other on the radial vein but nearer than on the cubital; transverse median vein of the hind wing somewhat arched, making at least a right angle with the median vein; discoidal vein almost interstitial; cubital vein bending backward somewhat near its middle, well developed beyond the transverse cubital; tegulæ pale ferruginous, sparsely punctured, with traces of golden pubescence in the center in some cases. (Plate VII, fig. 7.)

*Legs.*—Coxæ and basal portion of the trochanters black, the proportion in the latter segment varying; coxæ sericeous, with numerous

hairs, also present on the trochanters; rest of the legs ferruginous except the tips of the claws (Plate IX, fig. 18), which are black; spines ferruginous; hind tibiae yellow sericeous behind, their inner contour straight; fore metatarsi with nine (or sometimes ten) comb teeth, more than half as long as the metatarsus. (Plate VI, fig. 5).

*Male.*—Differs from the female as follows: Anterior margin of the clypeus less reflexed, broadly but slightly emarginate, without teeth; anterior tooth of the mandible less divided; legs more generally sericeous; fourth, fifth, sixth, and seventh ventral abdominal plates emarginate, this increasing posteriorly so that the seventh is quite deeply notched; the fifth, sixth, and seventh plates each with short ferruginous-brown hairs, particularly at the sides, where they almost form tufts; terminal plate with its posterior margin rounded at the sides, acuminate in the middle, very slightly carinate along the median line; last three plates above quite hairy; dorsal terminal plate sometimes with a median longitudinal groove on its anterior portion; its posterior margin evenly rounded; transverse median vein of the hind wing generally less arched and making no more than a right angle with the median vein.

*Variations.*—In some cases there are black areas on all the dorsal abdominal plates; the femora also show a few black markings, and less often the entire abdomen may be nearly all almost black. Northern specimens are liable to be particularly hairy, the hairs being pale yellow, giving the insects a fuzzy, pale, yellowish brown appearance, and partly concealing the pubescence, which also seems to be less developed in such specimens.

*Length.*—Females, 20–25 mm.; males, 16–23 mm.

This species has probably the widest distribution of any of the Chlorioninae in America. I have seen specimens from Maine, New Hampshire, Massachusetts, New York, Ontario, Wisconsin, Michigan, Illinois, and Colorado on the north, and from almost every State southward to Florida, Texas, New Mexico, northern and southern California, Utah, Nevada, and Colorado. I have also seen it from Mexico, and it is reported by Fox and Dücke from Brazil. Kohl and Cameron state that it occurs in Guatemala, Nicaragua, Costa Rica, Panama, Guiana, Venezuela, Cuba, Jamaica, and Santo Domingo. These last lists, however, include the subspecies, and I have no means of determining in which of these localities the typical form of the species occurs.

In Massachusetts it is taken in late June, July, August, September, and rarely in early October. It visits the flowers of sumach, clematis, asclepias, mint, ceanothus, and other plants.

A specimen of this species from Para, Brazil, has a ferruginous petiole, but in all other regards seems to be typical.

This species is well pictured in the Insect Book (Plate V, fig. 18).



## CHLORION (PROTEROSPHEX) ICHNEUMONEUM AURIFLUUM (Perty).

*Sphex auriflua* PERTY, Delect. anim., 1834, p. 142.

*Sphex ichneumoneus* var. *aurifluus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 431.

This subspecies differs from *C. ichneumoneum* as follows: The petiole and abdomen are ferruginous, the latter having a clear, reddish or resin-like shade; the legs, except the coxæ, are also of this color; the wings are rather fuliginous, but no more so than is sometimes the case in the typical form; the pubescence and hairs are a darker, richer golden, and the body as a whole appears somewhat more slender in proportion to its length than in the typical form. The length is about the same.

I have studied specimens of this subspecies from Florida (Chokoloskee) and from Cuba. Kohl reports it from Mexico and Venezuela. In some examples portions of the abdomen are darker than the rest.

## CHLORION (PROTEROSPHEX) ICHNEUMONEUM FULVIVENTRIS (Guerin).

*Sphex fulviventris* GUERIN, Duperry, Voy. Coquille, Zool., II, 1830, p. 1.

*Sphex ichneumoneus* var. *fulviventris* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 431.

This subspecies differs from the typical form as follows: Petiole and abdomen entirely ferruginous red, as in the last subspecies, more or less varied with darker; coxæ black; anterior trochanters partly, middle and posterior ones wholly ferruginous (I believe this may be variable); rest of the legs ferruginous except the claws and pulvilli which are dark or black, and the last tarsal segment which is sometimes darker than the rest; wings quite strongly fuliginous; mesonotum with a pubescent band along the anterior median groove; body hairs sometimes decidedly reddish.

*Length.*—20–27 mm.

I have examined specimens of this subspecies from Chokoloskee and Miami, Florida; Spanish Wells, Bahama Islands; Habana, Cuba, and from Jamaica. I have also seen specimens which are intermediate between this and the preceding subspecies.

## CHLORION (PROTEROSPHEX) CALIGINOSUM (Erichson).

*Sphex caliginosa* ERICHSON, Schomburgk, Reise in Guiana, III, 1848, p. 589.

*Sphex erythroptera* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 30, pl. III, figs. 1, 1a.

*Sphex caliginosus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 415.

Large, robust insects; body and legs entirely black; wings hyaline, with a dark yellowish-brown tinge near the base, the outer margins slightly fuliginous; hairs black.

*Female*.—Head large, rather quadrangular when viewed from above; clypeus quite convex laterally, coarsely, not closely punctured, and bearing long, rather stout, black hairs; its anterior margin reflexed, smooth, and with a broad shallow notch in the middle; sides of the frons and around the bases of the antennæ covered with long hairs; the antennæ appear to arise from slight depressions of the frons, which is very minutely punctured above except near the sides of the lateral ocelli; vertex and cheeks scatteringly-punctured, with long hairs; the cheeks nearly as wide as the eyes; antennæ black, the first segment of the filament longest, one-third longer than the second; mandibles black, stout, with a trace of dark ferruginous near the base of the anterior tooth; front face with scattered aciculations along its lower edge and with a number of long hairs on this edge or on the hinder face.

*Thorax*. Collar narrow, almost vertical in front and behind, not closely appressed against the mesonotum, rather flat near the median line; on the edge punctured, and with numerous hairs, shorter than those of the cheeks; prothoracic lobe sparsely, minutely punctured, with hairs of medium length and a fringe of pale brown hairs on its posterior margin; mesonotum minutely, closely punctured, covered with very short hairs; the anterior median groove not very pronounced; at the sides, beginning near the front edge of the tegulæ, the lateral margin is somewhat reflexed, this continuing backward, then inward on the hinder margin till the scutellum reaches its level; scutellum glistening, with minute, scattered punctures; with a broad, shallow, median depression behind; at each side near the anterior margin is a short, oblique ridge running outward and backward; post-scutellum glistening, sparsely, minutely punctured, with an evident median groove; median segment dull black, closely punctured, and quite closely covered with rather short, blackish, brownish, and grayish hairs, with a suggestion at some angles of faint transverse aciculations; the dorsum with a slight median depression, broadest behind; fovea rather narrow, crescentic; posterior end and sides of the median segment rather finely, not closely punctured, covered with rather long black hairs mixed with a few grayish ones; sides of the thorax with scattered punctures and long hairs; petiole straight, shorter than the posterior coxæ, with scattered minute punctures and long black hairs.

*Abdomen*.—Long, ovate, rather more pointed behind than in front; above glistening, with scattered very minute punctures, becoming larger and more noticeable on the last three, and particularly on the last two plates, which bear brownish-black hairs on their sides, longer on the terminal plate; beneath glistening, with scattered punctures, particularly on the sides of the plates, from which hairs arise; on the last three plates the punctures and hairs are more closely placed; the first ventral plate has two ridges diverging backward from the end of the petiole.

*Wings*.—Yellow hyaline, somewhat fuliginous along the outer margins and quite dark yellowish-brown near the base; cubital vein of the hind wing frequently bent backward slightly near its middle, obsolete beyond the transverse cubital which seems to be a part of it rather than a cross vein; from the middle of the backward bend is a shadow as of an obsolete vein running outward and backward; transverse median vein nearly straight, about at right angles to the median vein; tegulæ brownish-black behind, black in front, with a few minute punctures on the anterior portion; more or less reflexed on the margins.

*Legs*.—Black; coxæ, trochanters and outer side of the femora with black hairs; fore metatarsi with ten or eleven comb teeth more or less alternating with spines; hind tibiæ with the inner contour straight except for a slight, elongated enlargement near the base; claws slightly lighter colored in the middle.

*Male*.—Differs from the female as follows (taken from Kohl, as I have not seen this sex): Clypeus more strongly arched, its anterior margin truncate, without a reflexed edge; fifth, sixth, seventh, and eighth ventral abdominal plates with a thick clothing of brownish hairs.

*Length*.—Females, 28–34 mm.; males, 28–31 mm.

Specimens of this large species have been captured in Mexico, North Yucatan, British Honduras, Guatemala, Costa Rica, Panama, Venezuela, and Brazil, according to Kohl. Those I have seen were taken in Mexico, Santo Domingo, and Brazil, and one specimen taken Feb. 2, 1906, at Grenada, West Indies, which has the wings darker and more brownish than usual.

#### CHLORION (PROTEROSPHEX) PENNSYLVANICUM (Linnæus).

*Sphex pensylvanica* LINNÆUS, Centur. Ins. rar., 1763, p. 30 (not seen).

*Sphex pensylvanica* LINNÆUS, Amoen. acad., VI, 1763, p. 412 (not seen).

*Sphex pensylvanica* LINNÆUS, Syst. Nat., 12th ed., I, 1767, p. 941.

*Sphex pensylvanica* DE GEER, Mem. Hist. Ins., III, 1773, p. 586, pl. xxx, fig. 2.

*Sphex pensylvanica* FABRICIUS, Syst. Ent., 1775, p. 346.

*Pepsis pensylvanica* FABRICIUS, Syst. Piez., 1804, p. 211.

*Sphex pensylvanica* PATTON, Proc. Bos. Soc. Nat. Hist., XX, 1880, p. 383.

*Sphex pensylvanicus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 418.

Large, robust insects; body and legs black; hairs black; wings strongly fuliginous, with a bluish or violet reflection; pubescence generally absent, silvery when present.

*Female*.—Head broad, quite quadrangular from above, the cheeks being full; clypeus strongly arched, its anterior margin evenly rounded, slightly reflexed, with a pair of very short, broad lobes at the middle; its surface coarsely punctured, with many, long, stout hairs, and in some cases with traces of silvery pubescence at the sides below the eyes; frons rather less coarsely punctured, quite smooth between the base of the clypeus and the antennæ; with rather shorter

and more slender hairs, this being more noticeable near the ocelli; frontal suture well developed, continuing behind the ocelli; a suture runs obliquely backward just outside the ocelli; lateral ocelli nearer each other than to the eyes; vertex and cheeks rather finely punctured; with many quite long hairs, both being coarser on the lower part of the cheeks, which at their widest part are nearly as wide as the eyes; inner margins of the eyes parallel; antennæ black, the scape with short hairs; first segment of the filament longest; the filament rather brownish sericeous; mandibles stout, black, tinged near the bases of the teeth with ferruginous; each reaching to the base of the other when closed; the anterior face strongly marked with ridges and aciculations, the inner edge near its base with a row of long, black hairs, and a similar row, but longer, on the posterior face close to the outer edge.

*Thorax*.—Anterior face of the collar sloping upward at first from the neck below, then vertical; dorsal edge narrow from front to rear, rather flattened in the middle; posterior face closely appressed against the mesonotum; surface of the collar with numerous fine punctures and short hairs; prothoracic lobe with numerous hairs and a fringe of short, pale brown ones on the posterior margin; mesonotum closely, rather finely punctured, bearing many short hairs; its anterior median groove pronounced, extending backward one-third to one-half the length of the plate; lateral margin somewhat reflexed from the prothoracic lobe back to the posterior angle, then inward to where the scutellum rises to its level; scutellum large, quite high in the middle, with an evident median groove; its outer part in front reflexed; its surface minutely punctured and bearing short, erect hairs, chiefly at the sides; postscutellum narrow, with a median groove, with hairs and punctures about like the scutellum; dorsum of the median segment coarsely roughened, almost transversely rugose, with a median depressed line which broadens behind to form a depressed area; the surface with many short, erect hairs; fovea large, shallow, crescentic; posterior end and sides of the median segment like the dorsum but bearing longer, more closely placed hairs; meso- and metapleura smoother, with scattered punctures, fewest on the horizontal part and lower half of the vertical part of the metapleura; with scattered, long hairs; petiole short, straight, with numerous long hairs.

*Abdomen*.—Elongate ovate, about as much pointed in front as behind; quite gray sericeous above; the last two plates punctured and bearing hairs, both being coarsest on the last plate, the posterior margin of which is rather acuminate at its sides but bluntly rounded in the middle; beneath gray sericeous, with fine, scattered punctures and short hairs, both being more abundant and much coarser on the last two plates; posterior margin of the fifth plate emarginate; last plate narrow, rather conical, its posterior margin narrowly rounded.



*Wings*.—Strongly fuliginous, with a strong bluish to violet reflection inside the outer ends of the cells, beyond which it is absent; transverse median vein of the hind wing nearly straight, making a little more than a right angle with the median vein; discoidal vein nearly interstitial; the median, cubital, and subdiscoidal veins of both wings well developed beyond the ends of the cells; tegulae black, sericeous.

*Legs*.—All the coxae, trochanters, and femora grayish sericeous, with scattered punctures and hairs least developed on the hinder pair; tibial and tarsal spines black; inner contour of hind tibiae straight, the hinder face coarsely sericeous; fore metatarsus with nine comb teeth, shorter than half the metatarsus; the fringe on the hind tibial spine is coarse, almost tooth-like; tarsi rather sericeous.

*Male*.—Differs from the female as follows: with more or less of silvery pubescence on the front of the head; generally with a small, silvery pubescent spot on the mesopleuron behind the prothoracic lobe; sometimes one at the base of the hind coxa, and rarely, one in the form of a crescent above the petiole and one on the posterior side of the hind coxa; seventh ventral abdominal plate quite deeply excavated behind and with a tuft of black hairs at each side; terminal ventral plate frequently densely clothed with pale brownish hairs.

*Length*.—Females, 25–34 mm.; males, 19–28 mm.

This insect is quite common in the United States throughout the Upper and Lower Austral life zones. The most northern localities from which I have seen specimens are Durham, New Hampshire; Malden and Amherst, Massachusetts; New York, Indiana, Michigan, and Minnesota. From these States it is generally distributed to Georgia and Texas, while in the West I have seen examples from Folsom and Eldorado counties, California; and from Fort Lupton, Colorado. It should also occur in the mountainous regions of Mexico.

Howard (The Insect Book, Plate VII, fig. 20) gives a good picture of this insect.

#### CHLORION (PROTEROSPHEX) CHICHIMECUM (Saussure).

*Sphex chichimecus* SAUSSURE, Reise d. Novara, Hym., 1867, p. 40.

*Sphex chichimeca* CAMERON, Biol. Centr.-Amer., Hym., II, 1889, p. 33, pl. III, figs. 6, 6a.

*Sphex chichimecus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 420.

*Female*.—Unknown.

*Male*.—Black, with silvery white pubescent spots; wings transparent except on the outer margins and along the veins, where they are fuliginous, with faint bluish-violet reflection; rather slender insects.

*Head*.—Quite broad and somewhat quadrangular from above, though the cheeks retreat sharply from the hinder margin of the eyes; clypeus somewhat arched laterally, with a slight longitudinal ridge on its upper third; black, rather sparsely silvery pubescent, least in the middle, and

with numerous, quite long, erect, black hairs; anterior margin somewhat rounded downward at the sides, the middle slightly, broadly emarginate and with no reflexed rim; the clypeal pubescence extends upward on the frons to above the level of the antennæ, and at the sides nearly as far as the level of the anterior ocellus; entire surface of the frons and vertex quite thickly covered with long, black hairs; frontal suture noticeable, forking in front of the ocelli; lateral ocelli nearer each other than to the eyes; just behind the ocelli is a slightly elevated, transverse-oval area which is somewhat blackish sericeous; frons and vertex finely punctured; cheeks very flat, retreating sharply from the posterior margin of the eyes, very slightly silvery-white pubescent close to the edge of the eye, and quite thickly clothed with long, white hairs, longer and closer below; inner margins of the eyes converging downward somewhat; antennæ black, the scape with a tinge of ferruginous below; rather glistening; relative lengths of the filament segments  $\frac{2}{5}$ ,  $\frac{2}{17}$ ,  $\frac{3}{16}$ ,  $\frac{4}{17}$ ; mandible black, of moderate size, two-toothed, with a few short hairs on its posterior face and slight aciculations on its anterior face; the mandible seems to be rather short to reach the base of the other when closed.

*Thorax.*—Collar black, its anterior face almost vertical; dorsal edge with a narrow band of silvery-white pubescence; the edge is not evenly rounded, but somewhat raised at the middle; anterior face black sericeous, with numerous, fairly long, grayish hairs; posterior face vertical, not closely appressed against the mesonotum, though quite close to it; anterior face of the collar and dorsal surface of the neck meeting at a right angle; the sides of the former quite thickly covered with fairly long, grayish hairs; prothoracic lobe silvery-white pubescent behind, and with a few long, whitish hairs; mesonotum with a narrow, silvery-white pubescent band on each side, beginning opposite the front margin of the tegula and extending back to the posterior end of the plate, then inward to meet the band from the other side; elsewhere black, somewhat sericeous, and with numerous rather short, gray or dark hairs; scutellum rather high, arched, black sericeous, with a slight median longitudinal groove, rather finely punctured, and with short gray hairs; postscutellum silvery-white pubescent as far laterally as the groove leading to the stigma of the median segment, and with quite numerous gray hairs; median segment black, its dorsum dull, dead black, with numerous fine punctures and long, whitish hairs; posterior end not forming a sharp angle with the dorsum; fovea shallow, crescentic; posterior end sparsely silvery-white pubescent, chiefly behind, and not extending to the stigmatal groove; with numerous long, whitish hairs; there is a band of silvery-white pubescence extending from the hind coxa along the stigmatal groove about halfway to the stigma; behind and below the prothoracic lobe is a silvery-white pubescent spot on the mesopleuron, and also one above

the mesocoxa extending upward toward the other; remainder of the surface of the meso- and metapleura black, finely punctured, and quite thickly covered with rather long, whitish hairs, longest below and just under the base of the hind wing; petiole short, straight, black, with numerous long, whitish hairs, and apparently with a tinge of dull ferruginous above, close to its junction with the abdomen; the length of the petiole about four-fifths that of the second hind tarsal segment.

*Abdomen*.—Black with a bluish reflection; rather slender and about equally pointed at both ends; the first dorsal plate coarsely grayish sericeous and with numerous moderately long, whitish hairs; the other dorsal plates very slightly sericeous but glistening, and with numerous fine punctures; the sixth, seventh, and eighth plates more coarsely punctured, and with coarser black hairs, closer together at the sides; terminal plate evenly rounded behind; the posterior margins of the two preceding plates slightly emarginate; beneath, black, glistening, with a slight bluish reflection; with scattered, fine punctures and black hairs; on the first plate, just at the junction of the petiole and abdomen, is a short, median ridge; the sixth plate is narrowest, broadly, slightly emarginate behind; seventh plate emarginate behind, with a number of erect, short, black hairs on the lateral margin, not quite dense enough to form a tuft; eighth plate quite thickly covered with very short, grayish hairs, its hinder margin a little nearer to being pointed than rounded; in some lights a lesser amount of hairs along the median line gives the appearance of a faint, median ridge, not really present.

*Wings*.—Semihyaline except on the outer margin and along the veins where they are fuliginous with a faint, violet reflection; radial cell of the forewing somewhat fuliginous; transverse median vein of the hind wing slightly arched, forming very little less than a right angle with the median; discoidal vein not quite interstitial; cubital and radial veins well developed beyond the transverse cubital vein; tegulae black, slightly sericeous near the middle, and with fine, scattered punctures.

*Legs*.—Black; fore coxae sparsely silvery-white pubescent anteriorly, and with many long, gray hairs; the other coxae, the trochanters and the femora grayish sericeous and with many quite long, grayish hairs; tibiae slightly grayish sericeous, the hind pair longer than the femora, the others shorter; hind tibiae strongly brown sericeous behind; their inner contour straight; tarsi grayish to brownish sericeous.

*Length*.—Males, 19 mm. (one specimen); Kohl gives 24 mm.

I have seen but one specimen of this species, taken in Santo Domingo. Other captures were from Mexico (Orizaba). It seems to be rare. The specimen I have seen is in the collection of the American Entomological Society and bore a label in Cresson's handwriting, which indicated that he thought it might be the male of his *mandibularis*, an idea which may prove to be correct.



## CHLORION (PROTEROSPHEX) MANDIBULARIS (Cresson).

*Sphex mandibularis* CRESSON, Trans. Am. Ent. Soc., II, 1869, p. 293.

*Sphex mandibularis* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 447.

*Type*.—One female specimen collected by Dr. J. Gundlach in Cuba; now in the collection of the American Entomological Society in Philadelphia.

The following description has been prepared from the type:

*Female*.—Black; wings hyaline, the outer half somewhat fuliginous; pubescence rather dull, of a pale creamy brown color, perhaps not entirely natural; about the size of large specimens of *C. ichneumonum*, with a stout abdomen.

*Head*.—Rather quadrangular from above; clypeus quite strongly arched, black, its extreme lateral angle below the eye ferruginous; covered with brownish pubescence, thickest at the sides, and with long, black hairs; its anterior margin convex, evenly rounded, with a slight median notch; the pubescence extends up the sides of the frons to the level of the lateral ocelli; vertex with mixed blackish and whitish hairs which are quite long; cheeks stout, nearly as wide as the eyes, their greatest width lower down than usual; with a narrow pubescent band close behind the eye above; with a few black, and more gray hairs, most abundant and longest below; antennæ black, the scape with a few short hairs; the first segment of the filament longest; mandibles quite long, of the average stoutness, ferruginous to the bases of the teeth, the remainder black; the ferruginous part closely, coarsely grooved; with mingled ferruginous and whitish hairs behind.

*Thorax*.—Horizontal part of the neck with an oblique pubescent band running outward and backward on each side; anterior face of the collar nearly vertical; dorsal edge narrow, pubescent; posterior face closely appressed against the mesonotum; the surface black sericeous, with long, gray hairs; the dorsal edge evenly rounded from side to side, lower than the mesonotum; prothoracic lobe black, pubescent behind, and bearing long, gray hairs; mesonotum coarsely black sericeous; with a lateral, pubescent band beginning at the front of the tegula and running backward, then inward and almost or quite meeting the band of the other side; the anterior median groove pubescent; the surface of the mesonotum with numerous, rather short, gray, and a few black hairs; scutellum with a slight median groove; coarsely black sericeous and with numerous rather short hairs; postscutellum pubescent, without any evident groove; median segment quite thickly covered with long cream-colored hairs; behind and at the sides the same, except that the hairs are white and longer (the dorsum has been wet and the hairs are so matted that exact conditions there are uncertain); stigmatal groove present; there is a small pubescent spot behind the prothoracic lobe, a short, small band running upward from the middle



coxa, and a broader band running upward from the base of the hind coxa about half way to the stigma; the rest of the pleural surfaces black sericeous, with quite long, whitish hairs; petiole shorter than the hind coxa, straight, black, well clothed with short, and some longer, white hairs.

*Abdomen*.—Rather short, stout, ovate, more pointed behind than in front, black above; anterior plates sericeous, with a few scattered, rather coarse punctures on all the plates; the last three plates with short to long, black hairs; last plate rounded acuminate behind; beneath black, somewhat glistening, with scattered, rather coarse punctures and black hairs, most coarse and abundant posteriorly; the terminal plate rounded acuminate behind.

*Wings*.—Hyaline, slightly fuliginous along the veins and outer half; first transverse cubital vein of the fore wing curving into the second cubital cell; transverse median vein of the hind wing leaving the median at a right angle with the latter, but curving somewhat, almost at once, so that as a whole the angle between the two veins is less than a right angle; discoidal vein nearly but not quite interstitial; cubital vein well developed beyond the transverse cubital vein; tegulae black.

*Legs*.—Black; anterior coxae sericeous, almost pubescent outside, and with numerous long, gray hairs; posterior coxae slightly pubescent behind; the legs as a whole strongly sericeous; hind legs with a faint reddish-brown tinge; fore metatarsus with ten comb teeth about half as long as the metatarsus; diameter of the hind tibia gradually increasing outward, but with a slight additional increase near the tip; hind tibial comb coarsely fringed, almost with spines rather than hairs; posterior face of the hind tibia strongly brown sericeous; claws two-toothed, black.

*Length*.—Female, 23 mm.

This interesting insect seems to be different from any of the other species of *Chlorion* which I have seen. If not, it is certainly an aberrant. Its general appearance is such that I regard Cresson's suggestion that it may be the female of *C. chichimecum* as not unlikely to be correct. Thus far Cuba is the only locality known for it.

#### CHLORION (PROTEROSPHEX) BEATUM (Cameron).

*Sphex beata* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 31.

*Sphex beatus* KOHL, Ann. Natur. Hofmus. Wien, V, 1890, p. 424.

I have seen no specimens of this species in any of the collections which have come to me, accordingly I give here a translation of Kohl's description, making certain changes (he counts the pedicel as the first segment of the filament) of names, in order that it may agree with the other descriptions in this paper. This will also include Cameron's original description as Kohl included that in his. I have omitted Kohl's Latin diagnosis.

*Length*.—20 mm., male.

Form slender, also the legs and antennæ.

*Black*. Fore and middle legs in part rust red; hairs of the head and thorax yellow; almost no pubescent spots are noticeable; wings strongly fuliginous with blue-violet reflection.

Clypeus squarely cut off in front; inner borders of the eyes slightly converging toward the clypeus; nearest distance of the eyes at the vertex equal to the length of the first and half of the second filament segments; scutellum arched as usual.

Dorsum of the median segment finely transversely aciculate; petiole relatively long, as long as the second segment of the very elongated hind foot, also as long as the pedicel and first filament segment together; ventral plates of the fifth, sixth, and seventh segments without close, long hairs or pubescence; form of the ventral plate of the eighth segment; Plate XII, fig. 101.

Cameron has sent me the male but not the female to examine. Therefore I give here the description of that author:

*Nigra*, femoribus tibiisque anticis rufis, capite, pro et mesonoto dense aureo-villosis, metonoto dense albo-villoso; alis violaceis ♂ ♀.

Long, 30 mm.

*Habitat*.—Mexico, Temax, in north Yucatan (Gauger); Guatemala, Pantaleon, 1,700 feet (Champion).

On the head the golden pile is very dense, except on the center of the clypeus, and on the vertex and occiput (perhaps rubbed off); the pronotum in front is bare, and the center of the mesonotum also. Eyes parallel, but very slightly converging at the top. Clypeus with some large punctures, the apex rounded, the furrow wide and deep; basal half of the mandibles reddish, aciculate. Mesonotum slightly depressed toward the apex in the center, as is also the pronotum; metanotum opaque, coarsely transversely aciculate, densely covered with a soft, white, woolly pubescence, and slightly depressed in the center toward the apex. Petiole as long as the hind coxæ, sparsely covered with long, white hair. Apex of the abdomen slightly punctured and sparsely covered with long hair.

The statement as to the length of the species, 30 mm., appears to be an error, as the male type sent measures only 20 mm.

In some regards this description is suggestive of *Chlorion mandibularis* Cresson.

#### CHLORION (PROTEROSPHEX) BRASILIANUM (Saussure).

*Sphex brasiliensis* SAUSSURE, Reise d. Novara, Hym., 1867, p. 39.

*Sphex tinctipennis* CAMERON, Biol. Centr.-Amer., Hym., II, 1888, p. 32, pl. III, fig. 5.

*Sphex brasiliensis* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 426.

*Sphex brasiliensis* KOHL, Ann. natur. Hofmus. Wien, X, 1895, p. 60.

*Sphex brasiliensis* FOX, Proc. Acad. Nat. Sci. Phila., 1897, p. 376.

*Sphex brasiliensis* DUCKE, Zeits. f. Syst. Hym. u. Dipt., I, 1901, p. 242.

I have seen no specimens of this species, and am therefore obliged to give here a translation of the description given by Kohl:

*Length*.—20–25 mm., female.

Body black. Legs wholly black or more or less red. In the example described by Saussure the entire femora, tibiæ, and tarsi are rust red; in other examples in the Vienna Natural History Museum dark pitchy red spots show on the four anterior legs; Cameron's type has the legs entirely black. Wings pale, with a weak yellow reflection.

Head and thorax with rich pubescent spots; these are yellowish-white, nickel colored. This pubescence is present on the collar, as lateral bands on the dorsulum, upon the prothoracic lobes, as spots immediately behind this and on the mesopleuron above the middle coxa, as a streak following the stigmal groove on the metapleuron, on the postcutellum, and upon the hinder end of the median segment. In Saussure's specimen of *brasilianus* the entire end of the median segment is not pubescent, but ornamented by two stripes which are separated by a bare spot. Longer hairs dirty white.

Inner margins of the eyes parallel. Least distance apart of the eyes upon the clypeus less than double the length of the petiole, which is scarcely shorter than the second and longer than the third hind tarsal segment. Least distance apart of the eyes upon the vertex slightly greater than the length of the first segment of the filament. Dorsum of the median segment finely leather-like; somewhat shorter than in *texanus*, and therefore appears more compact.

Metatarsus of the fore legs with eight comb teeth on the outer border. Inner contour of the hind tibiae straight. (Kohl, 1890.)

*Male*.—Black. Legs for the greater part pitchy red; in the specimen before me the coxæ, the trochanters and the femora on their posterior side except on the tip are pitchy red. The long abundant hairs of the head, thorax, and median segment are dirty yellow; the collar above, the prothoracic lobes, and a spot behind them, a spot above the middle coxæ and another above the hind coxæ, the dorsulum on the inner border of the bases of the wings (lateral bands), the postscutellum and the median segment on both sides behind near the petiole are coppery yellow pubescent. Wings quite clear, with a weak yellow reflection.

Mandible two-toothed. The labrum shows only a hint of a median longitudinal ridge. The inner margins of the eyes converge toward the clypeus. The least distance apart of the eyes at the clypeus about equals the length of the first plus half that of the second filament segment; and upon the vertex equals that of the pedicel plus the first filament segment. The lateral ocelli are almost as far apart as they are from the eyes. The first filament segment is about as long as the second plus one-third of the third.

Scutellum with a longitudinal impress in the middle. Dorsum of the median segment finely leathery. Petiole somewhat longer than the second hind tarsal segment, and therefore long, as compared with many other species. The ventral anal plate is slightly ploughshare shaped and pointed, more than in *umbrosus* Chr. The upper anal plate with a strong curve. Structure of the genital apparatus illustrated as figure 34 of plate V; it most closely resembles that of *Sph. incomptus* Gerst. (Kohl, 1895.)

Some writers seem to regard *tinctipennis* Cameron as a variety or subspecies of *brasiliannum* rather than as the same. As I have not seen either I do not feel competent to express any opinion on the point. *C. brasiliannum* as such has not been reported from any localities within the limits of this paper, but *tinctipennis* has been taken in Costa Rica and Guatamala (El Tumbador, 2,500 feet). Kohl does not recognize any variety of *brasiliannum* and places *tinctipennis* in the synonymy; accordingly the description above should be satisfactory for the latter.

## CHLORION (PROTEROSPHEX) TEXANUM (Cresson).

*Sphex texana* CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 212.

*Sphex texanus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 427.

*Type*.—“Five male and female specimens. (Belfrage; Boll.)” In the collection of the American Entomological Society, in Philadelphia, are about a dozen specimens of this insect from Texas, one bearing Cresson's label, and which therefore must be regarded as one of the types. In the National Museum are two females and a male labeled “Texas Belfrage,” “Type No. 1688 U.S.N.M.” In the collection at Harvard College are two females marked “Dallas Tex. Boll Type.” Some one of these six must be a metatype or a homotype, but all are correctly identified at least.

Rather slender insects; body black, except the abdomen, which may be partly ferruginous; wings hyaline, slightly fuliginous on the outer margins; pubescence pale golden to silvery.

*Female*.—Head broad, quadrangular, the cheeks being quite broad; clypeus somewhat arched laterally, it and the frons thickly covered with pale golden to silvery pubescence to a point above the antennæ, and nearly to the ocelli in some cases, with long hairs of the same color; the pubescence is less thick on the middle and anterior margin of the clypeus, which is black, very minutely punctured, and also with coarse punctures; anterior margin of the clypeus evenly rounded, not noticeably reflexed, with a short, median, truncated projection, often concealed by the pubescence; portion of the frons not covered by pubescence minutely, sparsely punctured, sericeous; lateral ocelli nearer the eyes than each other; vertex and cheeks punctured like the frons; gray sericeous, the occiput and cheeks behind with a few pale hairs, longer on the lower part of the cheeks, which are three-fourths as wide as the eyes; inner margins of the eyes slightly converging toward the clypeus; antennæ black, the scape and pedicel with a dark ferruginous tinge; the scape with numerous short, yellowish hairs on its inner face, and a narrow, sericeous band in some cases; filament yellowish-gray, sericeous, its first segment longest; mandible black, with a ferruginous tinge from the base to the base of the teeth; with scattered aciculations on the anterior face, a few yellowish hairs on the inner edge, and a fringe of similar hairs on the lower edge of the posterior face; when closed, the tip of a mandible reaches beyond the base of the other.

*Thorax*.—Collar pale sericeous, its dorsal edge yellowish-silvery pubescent, the edge being slightly flattened in the middle; anterior surface nearly vertical, with scattered, long, pale hairs; posterior face not closely appressed against the mesonotum; prothoracic lobe black, its posterior half covered with pale golden to silvery pubescence, mingled with long, silvery hairs; mesonotum with a more



or less developed silvery pubescent band on each side, extending from in front of the tegula backward to the end of the plate, then inward toward the band of the other side, which it usually does not quite meet; median anterior groove very slight; surface of the mesonotum elsewhere sericeous, with very minute punctures, and scattered, coarser ones; scutellum black, sericeous in certain lights, with a few small, scattered punctures, and a very slight median groove; postscutellum silvery pubescent, with a median groove, the pubescence extending to the lateral edge of the dorsum of the median segment; dorsum of the median segment sericeous, with a slight, longitudinal, elongate-oval depression in front of the fovea; posterior end of the segment with two spots of dense, silvery pubescence, confluent at the middle and extending part way around the petiolar articulation; between these spots and the stigmal groove the surface is black, with short, transverse aciculations near the dorsum; entire surface of the median segment quite thickly clothed with pale hairs, longest behind; surface of the dorsum dull black, minutely roughened; mesopleuron with a pale pubescent spot just behind the prothoracic lobe; the rest of the plate black, quite smooth or very minutely punctured, and with many very short, erect, pale hairs; there is a very faint pubescent spot in front of and above the mesocoxa and a well-developed pubescent band running upward from the hind coxa along the stigmal groove to the stigma and in some cases showing a little behind the groove; aside from these pubescent areas the surface of the metapleuron is black, quite smooth, and sparsely covered with short hairs; petiole short, black, sericeous, bearing numerous whitish hairs.

*Abdomen.*—Elongate-oval, longer than the thorax, about equally pointed at both ends; sericeous above, particularly on the anterior half; the first and most of the second dorsal plates dull ferruginous, the amount of ferruginous varying in different specimens; remaining plates black or varied more or less with ferruginous; last two dorsal plates rather coarsely punctured, the punctures coarser and closer on the last, both plates bearing scattered brown hairs; beneath rather glistening, bearing a few scattered hairs on each plate, rather more abundant posteriorly; apparently extremely closely and minutely punctured, and with a few more pronounced, scattered punctures, which are most numerous posteriorly; dorsal and ventral terminal plates rather narrowly rounded behind.

*Wings.*—Hyaline, rather fuliginous on the outer margin, this being strongest on the fore wing and just beyond the end of the radial cell; first recurrent vein of the fore wing almost interstitial with the second transverse cubital vein; transverse median vein of the hind wing slightly arched, making rather more than a right angle with the median; discoidal vein not interstitial; cubital vein with a slight backward bend

near its middle, nearly or quite obsolete beyond the transverse cubital, these two meeting very sharply; cubital and subdiscoidal veins of the fore wing nearly or entirely obsolete beyond the ends of the cells; third cubital cell with almost no margin on the radial cell, the second and third transverse cubital veins almost meeting there; tegulae finely, sparsely punctured, blackish to more or less ferruginous.

*Legs*.—Black or very dark brown; anterior coxae sericeous in front, the middle and hinder ones only faintly so; hind coxae silvery pubescent behind; coxae and trochanters with short hairs, most abundant on the fore legs; fore femora quite hairy beneath and with a trace of a silvery pubescent line in some cases; all the femora with a few small, scattered punctures; tibiae and tarsi sericeous, the hind tibiae densely so behind; fore metatarsus with ten short comb teeth, the first shorter than the others; tarsi rather lighter than the other leg segments, their claws ferruginous except the tips, which are black.

*Male*.—Differs from the female as follows: Abdomen more sericeous above; cheeks about half the width of the eye; posterior half of the last dorsal abdominal plate closely covered with short, brown hairs pointing backward; the posterior margin of this plate evenly rounded at the sides and with a shallow notch in the center; seventh ventral plate quite excavate behind, with a fringe of yellowish hairs along its outside edge; terminal ventral plate rather narrow, with a median ridge, its posterior margin rounded at the sides, with a somewhat acuminate median projection; the abdomen as a whole black, but with a slight ferruginous tinge above at the base and on the first two or three segments beneath; tegulae variously mottled with black and dark ferruginous.

In some specimens the first recurrent vein of the fore wing is not nearly interstitial with the second transverse cubital and the amount of ferruginous on the abdomen of the male is quite variable.

*Length*.—Females, 21–24 mm.; males, 21–23 mm.

This pretty species appears to be quite common but local in its distribution, as all the specimens I have seen were captured in Texas. The only closer data are for two examples taken at Dallas. Cresson says it is a common species taken on *Solidago* flowers in September and October.

It is pictured in the Insect Book on Plate XI, figs. 3 and 6 (the latter being named *tenanus* by a misprint).

#### UNIDENTIFIED SPECIES.

I am unable to recognize the following species, which have been described as having been taken within the geographical limits covered in this paper, though I have in some cases ventured to guess at what they may be. The name given is that under which the description was published.

**SPHEX ARGENTATA** Dahlbom.

Smith<sup>a</sup> records this insect from Greece, India, Java, Africa, and from St. Johns Bluff, Florida. It is a well-known Old World species, and as no other record of its capture in America exists it is probably an erroneous record and may safely be omitted from the American faunal lists.

**SPHEX AURULENTA** Fabricius.

The only authority for this species as American is the locality "Am. bor." in Dalla Torre's *Catalogus Hymenopterorum*, and as there seems to be no other record of it from this country, while it is well known from India and China, I must consider this as an error and regard it as not an American insect.

**SPHEX CRÆSUS** Lepeletier.

*Sphex cræsus* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 351.

This insect was described from "Amerique Septentrionale. Montagnes rocheuses." Dalla Torre suggests that it may be a variety of *C. ichneumoneum*, and this may be correct.

**SPHEX DIMIDIATA** De Geer.

*Sphex dimidiata* DE GEER, Mem. Hist. Nat. Ins., III, 1773, p. 589, pl. xxx, fig. 5.

This species, which was from Pennsylvania, is compared with a *Sceliphron*, and it may also be one of that genus. The figure is of no assistance.

**SPHEX DIMIDIATA** Lepeletier.

*Sphex dimidiata* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 352.

From "Amerique Septentrionale." It may possibly be a fuliginous winged *C. ichneumoneum*.

**SPHEX DORSALIS** Lepeletier.

*Sphex dorsalis* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 347.

Lepeletier's description was prepared from a male taken at Cayenne. It is possible that it is a specimen of *C. spiniger*, with considerable ferruginous on the abdomen, but no certainty seems possible.

**SPHEX EXCISUS** Kohl.

*Sphex excisus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 362.

I am unable to separate this species by the description from *C. bifoveolatum* Taschenberg, as the differences are mainly those of relative lengths of different parts, and some specimens I have examined agree

<sup>a</sup>Cat. Hym. Brit. Mus., IV, 1856, p. 252.

with *arcisus* in some of these measurements and with *bifoveolatum* in others. As it is very possible that I have not seen this species I place it here.

**SPHEX INSTABILIS** Smith.

*Sphex instabilis* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 263.

This description is suggestive of an *Isodontia* in some regards, and I have wondered if it could be *C. exornatum*. The locality given is "North America."

**SPHEX MIXTA** Fabricius.

*Sphex mixta* FABRICIUS, Ent. Syst., IV, 1794, p. 457.

**SPHEX NEOXENUS** Kohl.

*Sphex neozenus* KOHL, Ann. natur. Hofmus. Wien, V, 1890, p. 363.

Kohl expresses doubt as to the correctness of the locality given on his specimen of this insect (Vancouver Island), as it looks to him more like a South American form. In a collection of *Sphex* from Argentina, which I have had the opportunity to study, are specimens which come nearer this species than any other, differing from it mainly in the amount and distribution of the color. I am therefore inclined to indorse Kohl's opinion and regard this as a South American species.

**SPHEX OPACA** Dahlbom.

*Sphex opaca* DAHLBOM, Hym. Eur., I, 1845, p. 437.

This may possibly be *C. flavitarsis*. It is from "Americ. merid."

**SPHEX PETIOLATA** Drury.

*Sphex petiolata* DRURY, Ill. Nat. Hist., II, 1773, p. 75, pl. xxxix, fig. 7.

From Jamaica. Apparently a *Sceliphron*.

**SPHEX SINGULARIS** Smith.

*Sphex singularis* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 261.

It is possible that an examination of the type of this species would show it to be the same as *C. spiniger*, though this can not be demonstrated from the description. It is from Honduras.

**SPHEX SINGULARIS** Cameron.

*Sphex singularis* CAMERON, Biol. Centr.-Amer. Hym., II, 1889, p. 33, pl. III, figs. 7, 7a.

From Mexico, Guatemala, Honduras, and Panama. Is it the same as the last?

**PEPSIS T** Palisot Beauvais.

*Pepsis T* PALISOT BEAUVAIS, Ins. rec. en Afr. and Amer., Hym., 1805, p. 117.

*Sphex T* SMITH, Cat. Hym. Brit. Mus., IV, 1856, p. 260.



Apparently a *Sceliphron*. The name was given because of a T-shaped mark on the back of the thorax, and none of the insects I have seen has such a mark.

The locality given is Santo Domingo.

**SPHEX VAGA** Christ.

*Sphex vaga* CHRIST, Natur. d. Ins., 1791, p. 305.

**SPHEX VIOLACEIPENNIS** Lepeletier.

*Sphex violaceipennis* LEPELETIER, Hist. Nat. Ins. Hym., III, 1845, p. 349.

Described from "Philadelphia." It may prove to be *C. (Palmodes) abdominalis* Cresson.

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## EXPLANATION OF PLATES.

The figures on the following plates were prepared by tracing from photographs as is shown in some cases by a lack of bilateral symmetry due to the angle at which the photograph was taken. In this way accuracy of outline and in the relation and proportion of the parts was assured, while at the same time other and non-essential features could be omitted, giving the figures the character of diagrams.

The plates are by the author.

## PLATE VI.

Fig. 1. Side view of the body of *Chlorion* (*ProterospheX*) *ichneumoneum*.

|                                      |                               |
|--------------------------------------|-------------------------------|
| <i>a</i> , prothorax.                | <i>d1</i> , dorsum.           |
| <i>a1</i> , neck.                    | <i>d2</i> , end.              |
| <i>a2</i> , collar.                  | <i>d3</i> , side.             |
| <i>a3</i> , prothoracic lobe.        | <i>d4</i> , stigma.           |
| <i>ac</i> , anterior coxa.           | <i>d5</i> , fovea.            |
| <i>b</i> , mesothorax.               | <i>d6</i> , stigmatal groove. |
| <i>b1</i> , mesonotum.               | <i>f</i> , funiculus.         |
| <i>b2</i> , scutellum.               | <i>fw</i> , fore wing.        |
| <i>b3</i> , mesothoracic episternum. | <i>hw</i> , hind wing.        |
| <i>b4</i> , episternal groove.       | <i>l</i> , lobe.              |
| <i>b5</i> , mesothoracic epimeron.   | <i>mc</i> , mesocoxa.         |
| <i>c</i> , metathorax.               | <i>p</i> , petiole.           |
| <i>c1</i> , postscutellum.           | <i>pc</i> , posterior coxa.   |
| <i>c2</i> , metapleuron.             | <i>s</i> , stigma.            |
| <i>c3</i> , metathoracic epimeron.   | <i>st</i> , sting.            |
| <i>c4</i> , metapleural lobe.        | <i>t</i> , tegula.            |
| <i>d</i> , median segment.           | 1-6, abdominal plates.        |

- Fig. 2. Dorsal aspect of the thorax of *Chlorion* (*Chlorion*) *cyaneum*. The median impressed lines on the mesonotum have been somewhat increased to show their appearance in other subgenera. Lettering as in fig. 1.
3. Hind tibia of *Chlorion* (*Proterosphex*) *cubensis*, showing the apical enlargement on the inner side.
  4. Hind tibia of *Chlorion* (*Proterosphex*) *lautum*, showing the curved inner contour of the piece.
  5. Hind tibial comb spine of *Chlorion* (*Proterosphex*) *ichneumoneum*, showing its fringe of hairs on the inner side.
  6. Hind tibial comb spine of *Chlorion* (*Priononyx*) *atratum*, showing the teeth on the inner side.

## PLATE VII.

- Fig. 7. Fore and hind wings of *Chlorion* (*Proterosphex*) *ichneumoneum*, with the veins named according to the usual nomenclature.

|                               |                                         |
|-------------------------------|-----------------------------------------|
| <i>a</i> , anal.              | <i>r</i> , radial.                      |
| <i>am</i> , apical margin.    | <i>re1</i> , first recurrent.           |
| <i>ax</i> , axillary.         | <i>re2</i> , second recurrent.          |
| <i>b</i> , basal.             | <i>s</i> , stigma.                      |
| <i>c</i> , costal.            | <i>sc</i> , subcostal.                  |
| <i>cu</i> , cubital.          | <i>sd</i> , subdiscoidal.               |
| <i>d</i> , discoidal.         | <i>si</i> , sinus.                      |
| <i>f</i> , fold.              | <i>tc</i> , transverse cubital.         |
| <i>ff</i> , frenal fold.      | <i>tc1</i> , first transverse cubital.  |
| <i>fh</i> , frenal hooks.     | <i>tc2</i> , second transverse cubital. |
| <i>m</i> , median.            | <i>tc3</i> , third transverse cubital.  |
| <i>pm</i> , posterior margin. | <i>tm</i> , transverse median.          |

- Fig. 8. The same wings with the veins named according to the nomenclature of Comstock and Needham.

## PLATE VIII.

- Fig. 9. The same wings with the cells named according to the usual nomenclature.

|                              |                               |
|------------------------------|-------------------------------|
| <i>a</i> , anal.             | <i>cu4</i> , fourth cubital.  |
| <i>ap1</i> , first apical.   | <i>d1</i> , first discoidal.  |
| <i>ap2</i> , second apical.  | <i>d2</i> , second discoidal. |
| <i>c</i> , costal.           | <i>d3</i> , third discoidal.  |
| <i>cu</i> , cubital.         | <i>m</i> , median.            |
| <i>cu1</i> , first cubital.  | <i>r</i> , radial.            |
| <i>cu2</i> , second cubital. | <i>sm</i> , submedian.        |
| <i>cu3</i> , third cubital.  |                               |

- Fig. 10. The same wings with the cells named according to the nomenclature of Comstock and Needham.

11. Outline of the posterior margin of the sixth ventral abdominal plate of *Chlorion* (*Priononyx*) *biforeolatum*, male, showing the median excision.
12. Antenna of *Chlorion* (*Proterosphex*) *ichneumoneum*.
 

|                        |                     |
|------------------------|---------------------|
| <i>b</i> , bulb.       | <i>p</i> , pedicel. |
| <i>fil</i> , filament. | <i>s</i> , scape.   |



## PLATE IX.

- Fig. 13. Wings of *Chlorion* (*Chlorion*) *cyaneum*.  
14. Wings of *Chlorion* (*Palmodes*) *laeviventris*.  
15. Wings of *Chlorion* (*Priononyx*) *atratum*.  
16. Wings of *Chlorion* (*Priononyx*) *ferrugineum*.  
17. Wings of *Chlorion* (*Isodontia*) *harrisi*.  
18. Claw of *Chlorion* (*Proterosphe*) *ichneumoneum*.  
19. Claw of *Chlorion* (*Priononyx*) *striatum*.  
20. Claw of *Chlorion* (*Priononyx*) *ferrugineum*.  
21. Fore tibial comb of *Chlorion* (*Proterosphe*) *ichneumoneum*.

## PLATE X.

- Fig. 22. Face of *Chlorion* (*Chlorion*) *cyaneum*.  
23. Face of *Chlorion* (*Palmodes*) *laeviventris*.  
24. Face of *Chlorion* (*Priononyx*) *atratum*.  
25. Face of *Chlorion* (*Proterosphe*) *ichneumoneum*.  
26. Face of *Chlorion* (*Isodontia*) *auripes*.  
27. Fore metatarsal comb of *Chlorion* (*Priononyx*) *ferrugineum*.



Fig. 1.

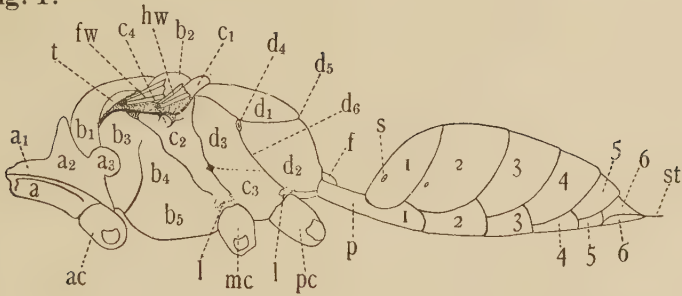


Fig. 2.

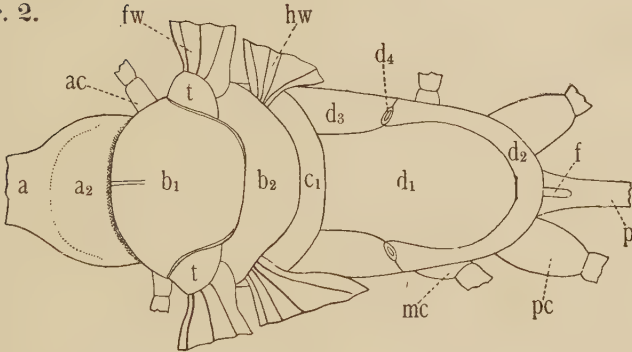


Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



NORTH AMERICAN DIGGER WASPS.

FOR EXPLANATION OF PLATE SEE PAGES 421-422.





Fig. 7.

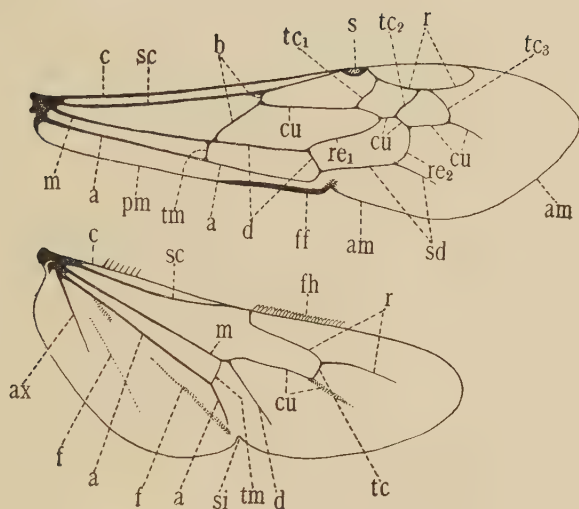
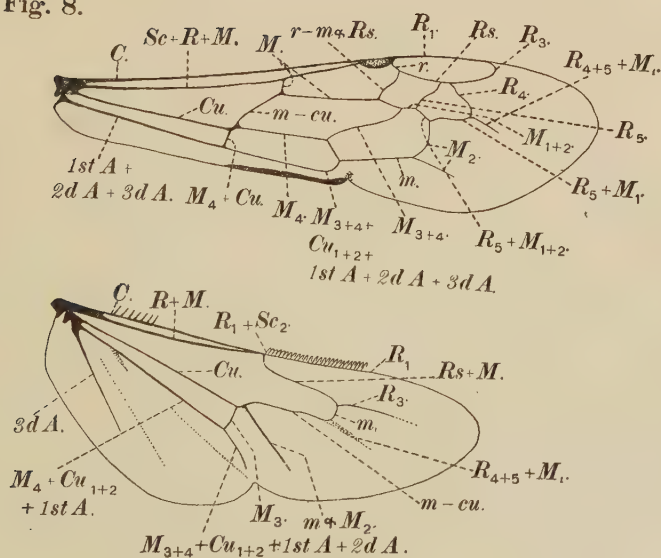


Fig. 8.



NORTH AMERICAN DIGGER WASPS.

FOR EXPLANATION OF PLATE SEE PAGE 422.



Fig. 9.

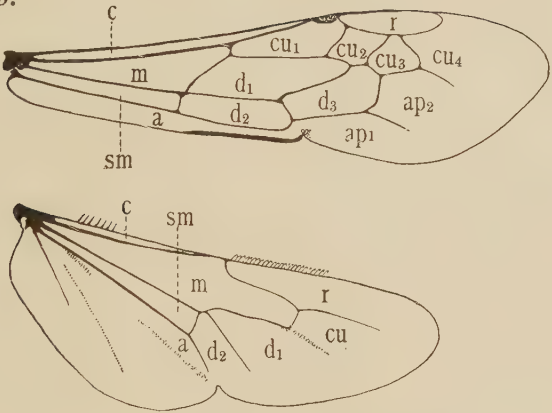


Fig. 10.

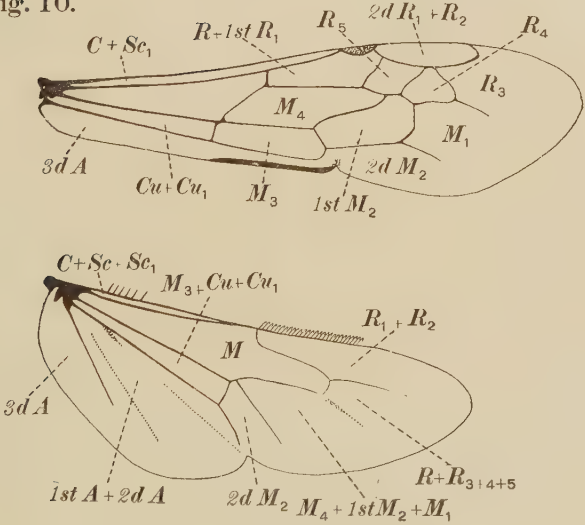


Fig. 11.



Fig. 12.



NORTH AMERICAN DIGGER WASPS.

FOR EXPLANATION OF PLATE SEE PAGE 422.





Fig. 13.

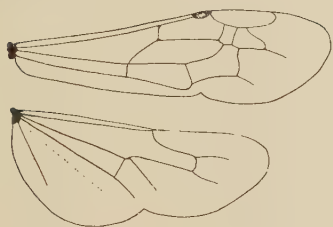


Fig. 14.

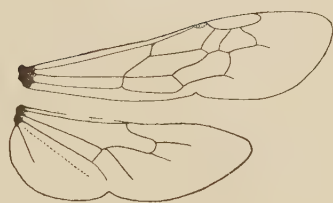


Fig. 15.

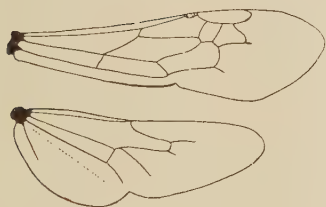


Fig. 16.

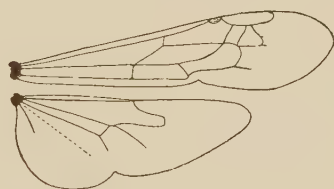


Fig. 17.



Fig. 18.



Fig. 20.



Fig. 19.



Fig. 21.

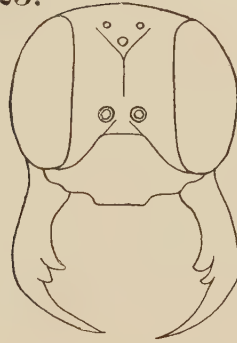




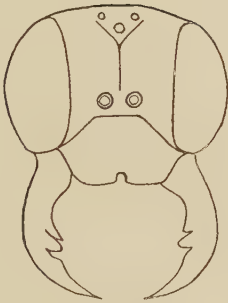
**Fig. 22.**



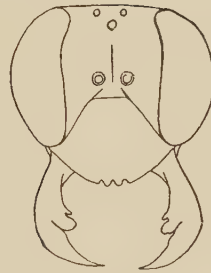
**Fig. 23.**



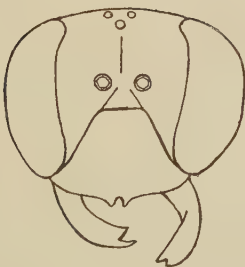
**Fig. 24.**



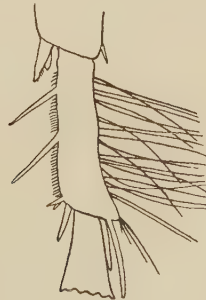
**Fig. 25.**



**Fig. 26.**



**Fig. 27.**



NORTH AMERICAN DIGGER WASPS.

FOR EXPLANATION OF PLATE SEE PAGE 423.





# ON THE DIURNAL LEPIDOPTERA OF THE ATHABASKA AND MACKENZIE REGION, BRITISH AMERICA.

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## INTRODUCTION.

During the summer of 1903 I was engaged in making a biological exploration in portions of the Athabaska and Mackenzie valleys for the United States Department of Agriculture. My time was chiefly occupied with the larger forms of life, but a good opportunity was afforded for making observations upon, and collecting a representative series of, northern butterflies. Nearly 150 specimens were taken, representing 45 species and subspecies. Two butterflies in this collection proved new to science. Dr. Harrison G. Dyar has recently described them as *Eneis caryi* and *Eneis nahanni*.<sup>a</sup>

The region traversed lies between the fifty-fifth and sixty-third parallels of latitude, and includes portions of the valleys of the Athabaska, Slave, and Mackenzie rivers, and of their lake basins, Athabaska and Great Slave lakes.

Edward A. Preble, also of the Department of Agriculture, whom I accompanied in 1903, made a small collection in August of that year at Fort Rae, Great Slave Lake, and on the traverse between that post and Great Bear Lake. Wintering at Fort Simpson, Mr. Preble spent the following summer in the lower Mackenzie Basin, and secured a representative collection of butterflies as far north as Fort McPherson (latitude 67° 20'). A new form of *Thanaos propertius*, from the mouth of Nahanni River, is described for the first time in the present paper.

These two collections, representing 53 species and varieties, form a very good basis for a preliminary report on the butterflies of this little-known region. I presented to the United States National Museum that portion of the material which was desired for the national collections.

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<sup>a</sup>Proc. Ent. Soc. Wash., VI, 1904, p. 142.

Most of the localities at which collections were made are somewhat obscure, and not all are indicated upon modern maps. With one exception they are trading posts of the Hudson's Bay Company. It may be well to mention the more important localities, with latitude and other data, in the following introductory list:

*Fort McMurray, Athabaska.*—At the confluence of the Clearwater and Athabaska rivers. Collections were made along the Athabaska River, near this post, early in August, 1903.

*Fort Chipewyan, Athabaska.*—On the north shore of Athabaska Lake near its outlet. The eastern portion of the lake was still ice-bound when I reached Chipewyan on June 1, 1903, but the western part had been navigable for some days. Vegetation was not far advanced at that time, but several balmy days in succession brought out many butterflies, and a number of species were collected. Fort Chipewyan is a good spot for collecting, there being many open, mossy slopes with a southern exposure on the Archæan hills about the post.

*Smith Portage, Athabaska (latitude 60°).*—A 16-mile portage around the Smith Rapids, connecting Smith Landing, Athabaska, and Fort Smith, Mackenzie. Butterflies were numerous in the muskegs<sup>a</sup> and about the water holes along the portage trail, June 11 to 13, 1903.

*Fort Resolution, Mackenzie.*—On the south shore of Great Slave Lake near the delta of Slave River. Fair collecting was obtained on the open ground between the post and the lake shore late in June.

*Hay River, Mackenzie.*—At the debouchure of Hay River on the southwest shore of Great Slave Lake. The last three days of June were spent here, but owing to the inclemency of the weather very little collecting was done. A few species were taken in a swampy tract adjoining the lake.

*Fort Rae, Mackenzie.*—On the northern arm of Great Slave Lake. A few species were collected by Mr. Preble in August, 1903. Hudsonian faunal conditions.

*Fort Providence, Mackenzie.*—On the north bank of the Mackenzie River, a short distance west of Great Slave Lake. Butterflies were numerous early in July. Many species were taken in the open pasture back of the post, chiefly at the flowers of the silverberry (*Eleagnus argentea*), and a species of gooseberry (*Ribes oxycanthoides*).

*Fort Simpson, Mackenzie (latitude 61° 52').*—At the confluence of the Liard and Mackenzie rivers. Mr. Preble collected here in May, 1904, and several collections have been made in the past. One of the best localities in the North for the lepidopterist.

*Mouth North Nahanni River, Mackenzie.*—West bank of Mackenzie River, 75 miles below Fort Simpson. The Mackenzie is here sharply

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<sup>a</sup>Throughout British America the term "muskeg" is applied to a peculiar type of swamp or bog in which moss has accumulated to a considerable depth. It usually supports a scanty growth of tamarack or spruce.

deflected to the northward by the Nahanni Mountains, an eastern spur of the Rockies, and a range of some 3,000 feet altitude closely parallels the river on the west. Several mountain forms of butterflies were taken in this vicinity, while on the plain between the river and mountains, where the typical northern spruce forest and muskeg conditions obtain, species of more general distribution were secured.

*Fort Norman, Mackenzie.*—On the Mackenzie River, near the mouth of Bear River. Mr. Preble collected a few species here in June, 1904.

*Fort Good Hope, Mackenzie (latitude 66° 15').*—On Mackenzie River. Some very interesting species were obtained by Mr. Preble late in June, 1904. A good locality for semi-Arctic forms. Hudsonian zone conditions predominate.

*Fort McPherson, Mackenzie (latitude 67° 20').*—On Peel River, 30 miles above its confluence with the Mackenzie. In this region the forest trees are very much dwarfed, and in places an approach to Barren Ground conditions is found. The butterflies which Mr. Preble obtained here early in July, 1904, were chiefly Arctic species and highly interesting from a geographic point of view, since they serve to fill in the gap between the Alaskan fauna and that of eastern Arctic America.

#### PREVIOUS WORK.

Although a few butterflies had been brought back to England from Boothia Felix by Sir John Ross, one of the earlier Arctic explorers, the vast region of tundra and forest on the mainland to the west and southwest, now known as Mackenzie and Athabaska districts, remained practically unexplored entomologically until 1825–26, when Franklin made his second journey to the Arctic regions. On this expedition, as on his first Arctic journey, 1819–1822, Franklin was accompanied by that most indefatigable naturalist, Dr. John Richardson, and valuable collections in various departments of natural history were secured. These collections were elaborated in the several volumes of *Fauna Boreali-Americana*, the insects being treated by Rev. William Kirby in the fourth volume, which appeared in 1837.<sup>a</sup>

Very nearly a quarter of a century then elapsed before any more entomological collecting was done in the Athabaska and Mackenzie regions. In 1848–49 Sir John Richardson made his third journey to the Arctic, this time accompanied by John Rae, and in search of his former companion, Franklin. The route followed from Lake Winnipeg was by way of the Saskatchewan River and Methye Portage to the Athabaska River, thence down the Athabaska, Slave, and Mackenzie rivers to the Arctic coast. The winter was spent at Fort Confidence, on Great Bear Lake, and the return journey in 1849 made over much the same route. A list of the entomological collections secured by Richard-

<sup>a</sup> For full reference to publications see Bibliography, p. 456.

son and Rae, with a very few annotations, was prepared by Adam White, and is to be found in the second volume of Richardson's narrative of the journey.<sup>a</sup> Sixteen species of butterflies, taken chiefly along the Mackenzie River, and on the Arctic coast<sup>b</sup> near its delta, are mentioned.

In the summer of 1862 Mrs. Christina Ross, wife of Bernard R. Ross, who was then in charge of Mackenzie district for the Hudson's Bay Company, collected a large number of butterflies at Fort Simpson, as well as at other points on the Mackenzie River and in the Great Slave Lake region. A considerable portion of Mrs. Ross' collection found its way into the hands of William H. Edwards, of Coalburg, West Virginia. In the three volumes of his great work on North American butterflies Edwards frequently refers to species obtained from Mrs. Ross.

At about the same period Woldemar Geffcken, of Stuttgart, Germany, received several large consignments of lepidoptera from officials of the Hudson's Bay Company. These were said to have been collected by Indian boys and girls in the region between Hudson Bay and Lake Athabaska. The late Dr. Herman Strecker, of Reading, Pennsylvania, afterwards came into possession of this material, and published an annotated list of thirteen species in his *Lepidoptera, Rhopaloceres and Heteroceres*. With the exception of Lake Athabaska, which is mentioned in connection with but two or three species, no definite localities are given—merely a vague reference to the general region between Hudson Bay and Lake Athabaska.

Small collections of butterflies have been made from time to time in various portions of the north by exploring parties sent out by the Canadian Geological Survey, and are now in the Government collections at Ottawa. In the early summer of 1888 R. G. McConnell journeyed down the Liard River to Fort Simpson, having crossed the Rockies from the Pacific. He collected four species of butterflies at the Devil's Portage, on the Liard (longitude  $126^{\circ} 10'$ ). In June and July of the same year Frederick Bell, an official of the Hudson's Bay Company, made a small collection at Fort Simpson at the instance of Mr. McConnell, securing ten species. During the same season William Ogilvie, while making an exploration of the lower Mackenzie Basin, took five species of butterflies, which were listed, together with the two collections mentioned above, in the Annual Report of the Canadian Geological Survey for 1887-88.

During the summer of 1892, Miss Elizabeth Taylor, daughter of

<sup>a</sup>Arctic Searching Expedition, II, 1851.

<sup>b</sup>Richardson's locality, "Arctic coast, between  $67\frac{1}{2}^{\circ}$  and  $68^{\circ}$ ," is commonly supposed to have been somewhere in the delta region of the Mackenzie River. His "Arctic coast" specimens, however, probably were collected east of the mouth of the Mackenzie, as butterflies were taken by the party as far east as Cape Krusenstern.



James W. Taylor, for some years United States consul at Winnipeg, traveled down the Athabaska, Slave, and Mackenzie rivers, going as far north as Fort McPherson. A collection of eighteen species of butterflies secured by Miss Taylor at various points along the route was deposited in the British Museum, and has been reviewed by A. G. Butler.<sup>a</sup>

Frank Russell, of the University of Iowa, made a zoological exploration in portions of the far north in 1893-94. Appended to his report<sup>b</sup> is a list of the insects collected, furnished by H. F. Wickham. Two species of diurnals were taken by Mr. Russell at Fort Rae.

I am informed by Francis A. Heron that the British Museum contains several species collected in the Great Slave Lake region in 1894 by W. G. Cumming, an English traveler.

In 1902, David T. Hanbury, the well-known English explorer, crossed the Barren Grounds from Chesterfield Inlet to Great Bear Lake. Assisted by his companion, Hubert Darrell, a small but highly interesting collection of Arctic butterflies was obtained at various points along the Arctic coast between Chapman Island and the mouth of the Coppermine River during June and the early part of July. Several species were also secured by Mr. Hanbury later in July on the traverse between Coppermine River and Great Bear Lake. H. J. Elwes has reviewed this collection in the Transactions of the Entomological Society of London for 1903.

The Government collections in Ottawa contain seven species of butterflies collected by James M. Macoun, of the Canadian Geological Survey, in the vicinity of Dunvegan, on the upper Peace River, Athabaska, during the summer of 1903. Mr. Macoun writes me that his collecting was done on the bench back from Peace River, at an altitude of about 2,500 feet. Dr. James Fletcher has kindly furnished me with determinations of this collection.

#### GENERAL ACCOUNT OF THE REGION.

The scope of country treated in the present paper is that part of northwestern British America known as the districts of Athabaska and Mackenzie. This territory lies between Keewatin on the east and the main range of the Rocky Mountains. The fifty-fifth parallel is the southern boundary, and it extends northward to the Arctic Ocean. The southern portion of the region is but slightly diversified. The monotony of seemingly endless spruce forest is relieved only by the numerous streams and chains of lakes. Muskegs and swales abound. Similar conditions obtain in the Mackenzie Basin almost to the delta, but the forest of spruce and poplar is less luxuriant north of latitude

<sup>a</sup> *Annals Nat. Hist.* (6), XII, 1893, pp. 12-14.

<sup>b</sup> *Explorations in the Far North*, 1898.

63°, and much dwarfed north of the Arctic Circle. Considerable open country is found on the upper Peace River, in western Athabaska, especially in the region known as the Grand Prairie.

In eastern and northern Mackenzie is found that vast area of open tundra commonly known as the "Barren Lands" or "Barren Grounds." This tundra region, while it does not lie entirely north of the Arctic Circle, is essentially Arctic in a zoögeographic sense. During the short summer season, extending from June to August, the Barren Grounds are covered with a profusion of wild flowers, and a number of species of Arctic butterflies lend their beauty to a landscape which for eight or nine months of the year is a frozen waste.

While traveling along the Arctic coast west of Bathurst Inlet in 1902, Mr. Hanbury first met with butterflies near Lewes Island on June 26, and remarks that numbers were to be seen June 27 on the southwest point of Chapman Island.<sup>a</sup> Some idea may be gained of the rapid progress and shortness of the summer season in this latitude (67° N.) from Mr. Hanbury's observations. Regarding the conditions of vegetation on July 12, near Point Epworth, we have the following: "Vegetation was very luxuriant, and the ground showed a profusion of blossom. The miniature rhododendron, with its mass of red blossom, the white blossom of our friend the *i-k/u-ti*, the heather \* \* \* and a white anemone were the most conspicuous."<sup>b</sup>

Writing in his journal July 15, when encamped a short distance west of Point Epworth (114° W., 67° 40' N.), Mr. Hanbury says: "Darrell collected butterflies for me. It did not appear as if I should be able to add largely to either collection [plants and insects], for both butterflies and flowers seemed to be nearly over. A blue lupin (*Lupinus nootkatensis*), which is very common in the Northland, was still in flower."<sup>c</sup>

The summer was rapidly drawing to a close when Hanbury reached the mouth of Dismal Creek, or Kendall River, at its junction with the Coppermine. He says: "Land on either side of the river was low, and supported a stunted growth of spruce trees. \* \* \* I collected a few butterflies, but they were now hardly worth taking. They had been much knocked about by wind and weather, and a large number of them could scarcely fly at all."<sup>d</sup>

The Athabaska-Mackenzie region is in most portions still a virgin wilderness, and the extreme difficulty of travel will for many years prevent a thorough exploration. Future work in the mountainous region west of the Mackenzie River will unquestionably add a number of mountain species of butterflies; while additional species may be

<sup>a</sup> Sport and Travel in the Northland of Canada, 1904, pp. 172-173.

<sup>b</sup> Idem, p. 190. <sup>c</sup> Idem, p. 192. <sup>d</sup> Idem, p. 209.

looked for from the Barren Grounds of eastern Mackenzie. The Grand Prairie region, and other open country on the upper Peace River, should also yield interesting species, several plains butterflies doubtless having their northern limits of range in this section.

A most important addition to our knowledge of northern butterflies will be in regard to their life histories. In the case of the majority of Arctic species these are yet to be worked out.

In the present list, which should be considered preliminary, I have attempted to collect and verify, so far as possible, the scattered records of the past, and thus bring under one heading our present knowledge of the distribution of butterflies in the region treated. I have included records from outside of Mackenzie and Athabaska wherever it has seemed advisable, and where such a record has an important bearing upon the distribution of a species in the north. Eighty-five species and subspecies of butterflies are now known to inhabit Mackenzie and Athabaska. Of this number 21 were collected in the region for the first time in 1903-4 by Mr. Preble and the writer.

The nomenclature and sequence followed in the annotated list of species is that of Dr. Harrison G. Dyar's List of North American Lepidoptera [= Bulletin No. 52, U. S. National Museum, 1902].

#### ACKNOWLEDGMENTS.

During the preparation of this paper the writer has been placed under obligations to Dr. Harrison G. Dyar, custodian of lepidoptera, U. S. National Museum, for the determination of some of the more obscure forms, as well as for access to the collections under his charge. My thanks are also cordially extended to Sir George F. Hampson and Francis A. Heron of the British Museum, who have kindly furnished me with data regarding specimens in the collections under their charge; likewise to William Beutenmüller of the American Museum of Natural History, New York. To Dr. James Fletcher and J. A. Guignard, entomologist and assistant entomologist, respectively, of the Canadian Department of Agriculture, I am also indebted—to the former for valuable information, and to the latter for access to the government insect collections at Ottawa.

#### LIST OF DIURNAL LEPIDOPTERA.

##### PAPILIO TURNUS Linnæus.

No specimens were taken by Mr. Preble and the writer, but nearly all of the earlier collections made in the region contained *Papilio* which have been referred to *turnus* by various writers. I have been unable to verify the earlier records of *P. turnus*, and it is possible some of them may have been based upon specimens of *P. rutubus*, the species which we secured in 1903-4.

White records specimens taken at Fort Simpson by Richardson in 1848.<sup>a</sup> Edwards formerly received several examples from Mrs. Ross, taken at Fort Simpson, and remarks upon their small size, as compared with United States specimens.<sup>b</sup> *P. turnus* is mentioned by Strecker among species collected in the Athabaska region, between Lake Athabaska and Hudson Bay, which he received from Geffcken. He also refers to the unusually small size and dark markings of northern specimens.<sup>c</sup> Five examples which Frederick Bell collected at Fort Simpson, June 24 to July 8, 1888, and others collected by R. G. McConnell at the Devil's Portage, Liard River (longitude 126° 10'), July 15, 1887, have been recorded by Doctor Fletcher.<sup>d</sup> A. G. Butler records two specimens of the small Arctic form of *P. turnus* in the British Museum which Miss Elizabeth Taylor collected in 1892.<sup>e</sup> One was taken June 3 on the "banks of the Athabaska River;" the other June 29, at the Rapids of the Drowned, Slave River.

PAPILIO RUTULUS (Boisduval).

This species was first met with on the Slave River, June 9, 1903, when one was seen flying across the stream at a point some 50 miles north of Fort Chipewyan. Several were also noted along the Smith Portage, June 12. They were common on the Slave River, near the Grand Détour,<sup>f</sup> June 16, and also at Fort Resolution, June 23 to 27. At Fort Providence numbers of these butterflies were seen on the blossoms of the silverberry (*Elæagnus argentea*), and two were secured July 8. Two were observed at Fort Simpson, July 10.

My two specimens from Fort Providence, and also a female taken by Mr. Preble at Fort Good Hope, June 25, 1904, are much smaller than more southern examples, with the black markings heavier. Mr. Preble saw the first Papilios flying near Fort Simpson, June 2, the earliest date for that latitude of which I have a record.

PAPILIO MACHAON var. ALIASKA Scudder.

During the middle of July, 1903, a few individuals of this fine species were observed on the Nahanni Mountains. I captured a single fresh example, July 16, on the summit of an isolated peak<sup>g</sup> not more than 5 miles from the confluence of the North Nahanni and Mackenzie rivers. The altitude of this mountain is about 2,500 feet. Mr.

<sup>a</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>b</sup> Butterflies of North America, II, 1884.

<sup>c</sup> Lepidoptera, Rhopaloceres and Heteroceres, 1872, p. 132.

<sup>d</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), pp. 229, 231 B.

<sup>e</sup> Annals Nat. Hist. (6), XII, 1893, p. 14.

<sup>f</sup> Fifty miles below Fort Smith, Mackenzie.

<sup>g</sup> Among the Slavé Indians this mountain is known as *Tha-on-tha* (lit. *by itself*), and for the sake of convenience I shall apply this name to it in the present article.



Preble took another specimen of *aliaska* on the north bank of the Mackenzie River, opposite the mouth of the North Nahanni River, July 25, 1904.

There appear to be but two previous records for this region. Edwards mentions the occurrence of *aliaska* as far east as Rupert's House, on the eastern shore of James Bay;<sup>a</sup> while Doctor Fletcher records a specimen taken at Fort McPherson, June 21, 1888, by William Ogilvie of the Canadian Geological Survey.<sup>b</sup>

This butterfly is chiefly a mountain form. It is common in Alaska, and probably also occurs in fair numbers throughout the mountain ranges west of the Mackenzie River. The Rupert's House specimen recorded by Edwards points at least to the probable occurrence of *aliaska* in the region between Hudson Bay and the Rocky Mountains.

#### PONTIA SISYMBRII (Boisduval).

A single specimen in beautiful condition was secured at Fort Chipewyan, June 4, 1903. A number of others were flying about the mossy Archæan rocks near the lake shore. It was a balmy spring day, and insect life was beginning to be astir in that northern latitude. Bees of the genus *Osmia* were common at the flowers of the bearberry (*Arctostaphylos uva-ursi*), and two or three species of *Bombus* were darting about the rocks.

Several butterflies of the genus *Pontia* which were seen flying across the Athabaska River 40 miles below Fort McMurray, May 29, may have been *sisymbrii*. Others noted on the Slave River, near Smith Landing, June 9, probably belonged to this species.

The Fort Chipewyan specimen extends the known range of *P. sisymbrii* far to the northward.

#### PONTIA NAPI var. OLERACEA (Harris).

Occurs abundantly throughout the region. This form was first noted on the Smith Portage, June 12, 1903, but had apparently been flying for some days. It was very numerous in open, grassy situations at Fort Resolution a week later. Numbers of these butterflies were collected.

White records a species of *Pontia* which Richardson collected at Fort Simpson.<sup>c</sup> This reference may have been either to a specimen of *P. oleracea* or *P. occidentalis*. Unfortunately the specimen cannot now be traced, and in all probability has been lost. Scudder, in his work on the Butterflies of New England, gives the following northern

<sup>a</sup> Rept. Nat. Hist. Collections in Alaska, Pt. 4, 1887, p. 327.

<sup>b</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 230 B.

<sup>c</sup> Arctic Searching Expedition, II, 1851, p. 362.

records for *oleracea*: "Mackenzie river, at lat. 65° (Kirby);<sup>a</sup> Great Slave Lake (Brit. Mus.); Athabasca region (Geffcken)."<sup>b</sup> Doctor Fletcher records 13 specimens which Frederick Bell collected at Fort Simpson in June, 1888.<sup>c</sup>

*P. oleracea* is the common form in Athabaska and the southern portions of Mackenzie,<sup>d</sup> being replaced farther north by the form *hulda* Edwards.

**PONTIA NAPI var. HULDA (Edwards).**

This is apparently the prevailing form in the region between the sixty-fourth parallel and the Arctic coast. Mr. Preble secured a goodly series in the summer of 1904 at the following localities in the lower Mackenzie Basin: Fort Norman, June 13; Fort Good Hope, June 21 to 23; Fort McPherson, July 6 to 8.

Kirby described *Pontia casta* from "three specimens taken in lat. 65°" (probably on the Mackenzie River).<sup>e</sup> The name of the collector is not given, but the specimens were very probably collected by Doctor Richardson, on Franklin's second expedition, in 1825-26. White, in Richardson's narrative,<sup>f</sup> records *Pontia casta* Kirby from the "Arctic Coast between 67½° and 68°."<sup>g</sup> The latter record is of specimens taken on Richardson's third journey, in 1848-49.

This butterfly has been recorded from Fort McPherson by Doctor Fletcher,<sup>h</sup> specimens having been taken at that post by William Ogilvie, June 21, 1888. A. G. Butler records specimens collected by Miss Elizabeth Taylor at Fort McPherson, July 15, 1892, and also at the Rapids of the Drowned, Slave River, June 29 and 30, 1892.<sup>i</sup>

**PONTIA OCCIDENTALIS (Reakirt).**

This species appears to be uncommon, and occurs only in the mountainous portions of Mackenzie. I captured a single example on the Nahanni Mountains, July 16, 1903, at an altitude of 2,000 feet. In 1904, Mr. Preble took two specimens at Fort Good Hope, June 21 to 23.

*P. occidentalis* has not been previously recorded from the region.

<sup>a</sup> Probably the type of "*Pontia casta*" Kirby. This specimen, which was formerly in the British Museum, has been lost. A. G. Butler treated the name *casta* as a synonym of *hulda* Edwards, and it seems best to thus consider it, as *hulda* is the common form at that latitude.

<sup>b</sup> Butterflies of Eastern United States and Canada, II, 1889, p. 1197.

<sup>c</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, 1889, p. 231 B.

<sup>d</sup> Strecker (Lepidoptera, Rhopaloceres and Heteroceres, 1872, p. 132), mentions several examples of *P. napi* var. *frigida*, which he received from Geffcken. No definite locality is given, merely "between Hudson's Bay and Lake Athabasca."

<sup>e</sup> Fauna Boreali-Americana, IV, 1837, p. 288, fig. 3.

<sup>f</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>g</sup> See Introduction, p. 428, footnote.

<sup>h</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 230 B.

<sup>i</sup> Annals Nat. Hist., (6), XII, 1893, p. 13.

## PONTIA OCCIDENTALIS CALYCE Edwards.

A specimen taken by Mr. Preble at Fort Good Hope, June 21, 1904, proves referable to the present form, and greatly extends its range northward.

## SYNCHLOE AUSONIDES (Boisduval).

This beautiful species is common throughout the region. In 1903, I first observed it on the Smith Portage, June 12, and secured fresh examples at Fort Smith two days later. It was present at all localities visited that season as far north as the Nahanni Mountains, and a fine series was collected. Mr. Preble found it at Fort Good Hope, in 1904, and took two males. He observed it flying at Fort Simpson as early as May 19. *S. ausonides* is usually found in open, grassy situations; occasionally in muskegs, but more often on higher ground.

White records a *Synchloe* which Richardson collected on the "Arctic Coast between lat.  $67\frac{1}{2}^{\circ}$  and  $68^{\circ}$ ," in 1848, as "*Anthocharis* —? n. s. (near *A. simplonia*)."<sup>a</sup> Richardson's specimens were doubtless *ausonides*, as this species is the only one known to occur in the far north. Doctor Fletcher records a specimen taken by Ogilvie on "Mackenzie River", July 8, 1888.<sup>b</sup> Under the name *Euchloe simplonia* Butler records specimens of this species which Miss Elizabeth Taylor collected at the Rapids of the Drowned, Slave River, June 29, 1892.<sup>c</sup> *E. simplonia* is a European species.

## EURYMUS HECLA (Lefebvre).

Elwes records four males and three females which were collected by David Hanbury on the Barren Grounds of eastern Mackenzie at  $114^{\circ}$  W.,  $67^{\circ} 40'$  N. (Arctic coast, in the vicinity of Point Epworth) July 13 to 16, 1902.<sup>d</sup> Mr. Preble captured a single male example at Fort Good Hope, June 20, 1904.

*E. hecla* is strictly an Arctic species, and could not reasonably be expected to occur in the heavy forest region of southern Alberta and Athabaska.

## EURYMUS BOOTHII Curtis.

This variable Arctic species, described from *pa* by Richardson taken in Mackenzie by but two explorers. and  $68^{\circ}$ ."<sup>e</sup> In 1902

White mentions specimens of this butterfly collected by Richardson in 1848 "on the Arctic Coast, between lat.  $67^{\circ}$  and  $68^{\circ}$ ."<sup>e</sup> In 1902

<sup>a</sup> Arctic Searching Expedition, II, 1851, p. 242.

<sup>b</sup> Ann. Rept. Can. Geol. Surv., III (no. 1), p. 242.

<sup>c</sup> Annals Nat. Hist. (6), XII, 1893, p. 242.

<sup>d</sup> Trans. Ent. Soc. London, Pt. 3, 1851, p. 362.

<sup>e</sup> Arctic Searching Expedition, Pt. 1, App. IV, (1889), p. 231 B.

Hanbury found it fairly common at Point Epworth, July 7; Gray's Bay, July 3; and on the Barren Grounds (Arctic coast, between Point Epworth and the mouth of Coppermine River), July 13 and 14; taking a number of specimens.<sup>a</sup>

**EURYMUS OCCIDENTALIS** (Scudder).

Apparently an uncommon species in the north. We did not meet with it in 1903-4.

The cotype came from Fort Simpson, Mackenzie.

Edwards mentions specimens taken on Mackenzie River,<sup>b</sup> presumably at Fort Simpson, by Mrs. Ross; while Doctor Fletcher records a specimen which Frederick Bell collected at Fort Simpson, July 17, 1888.<sup>c</sup>

*E. occidentalis* has a more western range than any of the other species of *Eurymus* recorded from Mackenzie and Athabaska. Doctor Scudder based his original description of the species upon specimens from the Gulf of Georgia, British Columbia, and Fort Simpson, Mackenzie.

**EURYMUS CHRISTINA** (Edwards).

The type of this species came from Smith Rapids, Athabaska.

This large and extremely variable species seems to be by far the most abundant *Eurymus* in the southern portions, where it has a general distribution. I did not meet with it in 1903, but in 1904 Mr. Preble collected several at Fort Good Hope, June 21, and a series of 15 specimens near the mouth of the North Nahanni River, July 25. Mr. Preble's specimens are of both sexes, and exhibit a great amount of variation, especially in the amount of orange suffusion on the fore wings of the males. It is probable that *E. christina* does not appear until reasonably late in the summer. In 1903, I spent nearly a week during the middle of July at the mouth of the North Nahanni River, where Mr. Preble secured his fine series in 1904, but captured only *E. palaeno*. Doctor Fletcher writes me that during the same season M. Macoun of the Canadian Geological Survey collected specimens in the vicinity of Dunvegan, Athabaska, on the upper Peace River.

Edwards named this species after Mrs. Christina Ross, who collected specimens at the "Portage of Slave River" [Smith Rapids] in 1889. He mentions numerous examples of *christina* received from Dr. Geffcken, which had been taken in the region to the west of the Bay, many of them from near Lake Athabaska.<sup>e</sup> It is at a maximum in Doctor Strecker's series,

<sup>a</sup> 1903, p. 242.

<sup>b</sup> 1879 [p. 57].

<sup>c</sup> (Trans. Am. Mus. Nat. Hist., ser.), Pt. 1, App. IV, (1889), p. 231 B.

<sup>e</sup> 1872, p. 133.



and a marked geographical variation was also exhibited, males from Lake Athabaska being much more heavily suffused with orange than Hudson Bay specimens. Doctor Fletcher records two examples which Frederick Bell collected at Fort Simpson—a male, July 17, and a female, July 25, 1888; and also lists the species from Fort Good Hope, where William Ogilvie secured it August [July?] 11 of the same year.<sup>a</sup>

*E. christina* has its center of abundance in the Saskatchewan region.

#### EURYMUS PALAENO (Linnæus).

This species occurs in small numbers from Fort Providence northward, and is usually seen in grassy muskegs. I collected six specimens in 1903, as follows: Fort Providence, July 8, four; Nahanni Mountains, July 16, two. Mr. Preble did not meet with this butterfly on the lower Mackenzie River in 1904.

White records specimens secured by Richardson at Fort Simpson in 1848.<sup>b</sup> Edwards based his description of *Colias helena* (= *palaeno* Linnæus) upon specimens "from Mackenzie's River, taken by Mrs. Ross."<sup>c</sup> Doctor Strecker mentions 25 specimens of *E. palaeno* in the collection he received from Geffcken.<sup>d</sup> It is probable that some of the latter were taken within Athabaska district.

#### EURYMUS ALEXANDRA var. EMILIA (Edwards).

I found this large, handsome *Eurymus* in small numbers at Fort Providence early in July, 1903, and also saw one or two near the mouth of the North Nahanni River a week or so later. Two males taken at Fort Providence, July 8, were in excellent condition. This butterfly was observed only in grassy muskegs.

*E. emilia* is a western form, and has not been previously recorded from the north.

#### EURYMUS NASTES (Boisduval).

Elwes records four males and two females from the Barren Grounds 140° W., 67° 40' N.<sup>e</sup> These specimens were taken by the Hanbury expedition in 1902. Francis A. Heron, of the British Museum, has kindly gone over these specimens for me, and refers them to the variety known as *rossii* Guenée.

*E. nastes* is another Arctic species which could not be found to occur in the forested regions west of Great Bear and

<sup>a</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, p. 10.

<sup>b</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>c</sup> Proc. Ent. Soc. Phila., II, 1863, p. 80.

<sup>d</sup> Lepidoptera, Rhopaloceres and Heteroceres.

<sup>e</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 5.

## EURYMUS PELIDNE (Boisduval).

Three pairs are mentioned by Elwes.<sup>a</sup> They were collected by the Hanbury expedition, as follows: One male, Arctic coast, 16 miles west of Point Epworth, July 11; two males and two females on the Burren Grounds, 114° W., 67° 40' N.; one pale female, Dismal Creek (Kendall River), at its confluence with the Coppermine River, July 30.

In addition to the above series the British Museum collection contains a female specimen of *E. pelidne* from Great Slave Lake, taken in July, 1894, by W. G. Cumming; also a pale female from Fort Good Hope, collected by Miss Elizabeth Taylor, July 19, 1892.<sup>b</sup> Mr. Francis A. Heron considers both of these specimens referable to *pelidne*.

## ARGYNNIS ATLANTIS Edwards.

This species was first observed at Fort Providence, July 4, 1903. On July 16, I captured a pair on the summit of Mount Tha-on'-tha, in the Nahanni Mountains, at an altitude of 2,500 feet. On my outward trip in August I saw a number of these butterflies near House River, Athabaska,<sup>c</sup> and secured a specimen August 21. Mr. Preble took one at the mouth of the North Nahanni River, July 25, 1904.

The following record is given by Scudder: "Arctic America, Ross (Brit. Mus.)."<sup>d</sup> This reference is probably to a specimen, or specimens collected by Mrs. Ross at Fort Simpson, or some other point on the Mackenzie River, in the early sixties of last century. The species is recorded by Butler,<sup>e</sup> from Fort McMurray, Athabaska, where it was collected by Miss Elizabeth Taylor, August 17, 1892.

## ARGYNNIS ELECTA Edwards.

Dr. James Fletcher, of Ottawa, writes me that J. M. Macoun, of the Canadian Geological Survey, collected this species in the vicinity of Dunvegan, Athabaska, in the summer of 1903.

## ARGYNNIS EURYNOME var. CLIO Edwards.

Through Doctor Fletcher I learn that the Canadian government collection at Ottawa contains this species from Peace River, Athabaska, and near Dunvegan, where J. M. Macoun collected it in the

<sup>a</sup>Elwes, London, Pt. 3, 1903, p. 243.

<sup>b</sup>Elwes, London, Pt. 3, 1903, p. 243. (Annals Nat. Hist. (6), XII, 1893, p. 13).

<sup>c</sup>Elwes, London, Pt. 3, 1903, p. 243. (Annals Nat. Hist. (6), XII, 1893, p. 13).

<sup>d</sup>Elwes, London, Pt. 3, 1903, p. 243. (Annals Nat. Hist. (6), XII, 1893, p. 13).

<sup>e</sup>Elwes, London, Pt. 3, 1903, p. 243. (Annals Nat. Hist. (6), XII, 1893, p. 13).

## BRENTHIS MYRINA (Cramer).

This large *Brenthis* was common in a grassy tamarack swale near the mouth of the North Nahanni River, July 13 to 17, 1903, where I captured a single specimen. The species was not noted elsewhere in the north by either Mr. Preble or myself.

Butler records specimens of *B. myrina* collected by Miss Elizabeth Taylor at the Rapids of the Drowned, Slave River, July 1, and at Fort Good Hope, July 18, 1892.<sup>a</sup>

This species is common in portions of Alaska, and has been taken in the region south of Hudson Bay; thence westward to the Lake Winnipeg region, and also at Edmonton, Alberta (latitude 54°). It undoubtedly has a general distribution in the lake country of Athabaska and southern Mackenzie, which future work will prove more satisfactorily.

## (?) BRENTHIS BELLONA (Fabricius).

Formerly listed by Edwards from "Great Slave Lake", probably in error.<sup>b</sup> It scarcely seems possible that this southeastern species ranges to the latitude of Slave Lake, almost in the Hudsonian zone.

## BRENTHIS PALES (Denis and Schiffermüller).

This European species is very rare in America, having been recorded only from Alaska previous to Mr. Elwes's review of the Hanbury collection. Among these butterflies were three males and a female of *pales* from the Barren Grounds (Arctic coast, 15 to 30 miles east of the mouth of Coppermine River), taken July 16 to 18, 1902. Elwes considers these specimens quite typical, having compared them with Alpine and northern Siberian examples.<sup>c</sup>

## BRENTHIS CHARICLEA (Schneider).

Mr. Hanbury took this species at all localities where he collected on the Barren Grounds in 1902. Elwes remarks upon the great amount of individual variation exhibited by the different specimens, and figures a melanistic male from Chapman Island, a small male from Dismal Creek, very pale, and a large female from Point Epworth, the latter the most peculiar aberration.<sup>d</sup> I am informed by Francis A. Herzog that in addition to the Hanbury series the British Museum collection contains three males and one female of *B. chariclea* from Slave Lake, collected in July, 1894, by W. G. Cumming.

<sup>a</sup> Annals Nat. Hist. (6), XII, 1893, p. 12.

<sup>b</sup> *Fide* Scudder, Butterflies of Eastern United States (note.)

<sup>c</sup> Trans. Ent. Soc. London, Pt. 3, 1903.

<sup>d</sup> *Idem*, pl. ix, pp. 242-243.

Doctor Strecker refers to this species a number of examples of *Brenthis* which he received from Geffcken. These were said to have been collected in the Athabaska region.<sup>a</sup>

**BRENTHIS CHARICLEA** var. **BOISDUVALII** (Duponchel).

I found this beautiful variety only upon the summit of Mount Thaoñ-tha, in the Nahanni Mountains, Mackenzie, where two were captured, July 16, 1903. The insects were flying in a crater-like depression grown up with *Viburnum*, *Rosa*, and *Delphinium*. Mr. Preble secured a specimen at Fort Rae, July 29, 1903; one at Fort Simpson, May 22, 1904; and four at the mouth of the North Nahanni River, July 25, 1904.

I can find no published records of this variety for the Athabaska-Mackenzie region.

**BRENTHIS TRICLARIS** (Hübner).

This species is uncommon, if not rare, in the Athabaska-Mackenzie region. It was not secured by either Mr. Preble or myself in 1903-4. Edwards records it from Fort Simpson;<sup>b</sup> while Strecker mentions a number of specimens from the Athabaska region.<sup>c</sup>

**BRENTHIS FREIJA** (Thunberg).

I secured my first specimen of this species at Athabaska Landing, Alberta, May 15, 1903. It was next noted on the Smith Portage, June 12 and 13, where a fine series of both sexes was collected. At Fort Simpson in 1904 Mr. Preble first observed *B. freija*, May 15, on which date he collected three males. He informs me the insects were then just beginning to appear, but were common about the post a week later. Farther down the Mackenzie River Mr. Preble took two males at Fort Good Hope, June 22, and another specimen at the mouth of the North Nahanni River, July 25, 1904.

Butler records a specimen from Fort Good Hope, Mackenzie, collected July 18, 1892, by Miss Elizabeth Taylor.<sup>d</sup>

Edwards apparently did not find *freija* in Mrs. Ross's collection, but Strecker mentions several specimens from the Athabaska region which he received from Geffcken.<sup>e</sup>

*Brenthis* which Richardson secured on the "Arctic coast between 68°,"<sup>e</sup> was listed by White as the form *tarquinius* Curtis.<sup>f</sup> This dark Arctic variety was collected in Boothia Felix by the early thirties of last century.<sup>g</sup>

Rhopaloceres and Heteroceres, 1872, p. 132.

North America, I, 1879 [Synopsis, p. 14].

Rhopaloceres and Heteroceres, 1872, p. 133.

XII, 1893, p. 12.

(note).

I, 1851, p. 362.

, App., 1835, p. 68.



## BRENTHIS POLARIS (Boisduval).

In 1903, I did not meet with *B. polaris* in the region south of Fort Wrigley (latitude 63°). Mr. Preble captured a single example at Fort Good Hope, June 20, 1904.

Mr. Hanbury found this species fairly common along the Arctic coast early in July, 1902, according to Elwes.<sup>a</sup> Specimens were taken by the Hanbury expedition, as follows: Gray's Bay, July 3, two males, one female; Point Epworth, July 9 and 12, one pair; Barren Grounds, 114° W., 67° 40' N., one pair.

*B. polaris* is a species of the Arctic fauna, occurring rarely in the Hudsonian.

## BRENTHIS FRIGGA (Thunberg).

This beautiful species was first observed on the Smith Portage, June 12, 1903. Three males and four females were collected at this point. Another individual, which was not captured, was noted at Fort Providence, July 8. In 1904, Mr. Preble collected four specimens at Fort Good Hope, June 21 and 22—three males and a female.

The only previous record is from Fort Simpson. In his report on the butterflies collected by E. W. Nelson in Alaska, Edwards compares specimens of *B. frigga* from St. Michael with Fort Simpson examples.<sup>b</sup>

*B. frigga* is a splendid butterfly, and as it flits about in a grassy muskeg the rich purplish brown on the underside of the secondaries contrasts most beautifully with its surroundings. Specimens are not difficult to capture, as the flight is slower and weaker than with the majority of the genus.

## BRENTHIS FRIGGA var. SAGA (Kaden).

A male example of this variety was collected at the Rapids of the Drowned, Slave River, June 29, 1892, by Miss Elizabeth Taylor, and is now in the British Museum. This specimen has previously been recorded as *B. bellona* by A. G. Butler,<sup>c</sup> but I am informed by Francis A. Heron that it is properly referable to the present form.

Strecker records specimens secured by Geffcken from the "Athabasca region."<sup>d</sup> Whether these specimens were actually collected within the limits of Athabaska district is an open question, as no definite localities are given.

<sup>a</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 241.

<sup>b</sup> Rept. Nat. Hist. Collections in Alaska, Pt. 4.

<sup>c</sup> Annals Nat. Hist. (6), XII, 1893, p. 12.

<sup>d</sup> Lepidoptera, Rhopaloceres and Heteroceræ.

**BRENTHIS FRIGGA** var. **IMPROBA** (Butler).

The type came from Mackenzie River delta.

Hanbury secured two pairs on the Barren Grounds, 114° W., 67° 40' N., and a male at Point Epworth in 1902, which Elwes considers typical of this form.<sup>a</sup> Butler based his description of *Argynnis improba* upon specimens taken by Richardson between latitude 67½° and 68°, in the Mackenzie River delta. These specimens, much worn, were presented to the British Museum by Richardson in 1851.

**PHYCIODES BATESII** (Reakirt).

A specimen of *Phyciodes* which I collected at Fort Providence early in July, 1903, seems to be referable to *P. batesii*, although greatly extending the previously recorded range of that species. Compared with specimens of *P. tharos* from New York, the Fort Providence specimen differs in having a pale yellow or almost white band beyond the cell of the fore wings. The black bars in the cell of the primaries also do not extend below the median vein.

**PHYCIODES THAROS** (Drury).

Represented in Mr. Preble's collection by a fresh female from Fort McPherson, July 8, 1904, and a battered example from the mouth of the North Nahanni River, July 25.

Previously recorded by Scudder, who gives the two following references: "Mackenzie River (Edwards); Upper Liard River (Dawson)."<sup>b</sup> Doctor Fletcher records specimens collected by R. G. McConnell, of the Canadian Geological Survey at the Devil's Portage, Liard River (longitude, 126° 10'), in 1888.<sup>c</sup> Butler records two males and a female of this species which were collected at the Rapids of the Drowned, Slave River, June 29, 1892, by Miss Elizabeth Taylor.<sup>d</sup>

**PHYCIODES THAROS** var. **MORPHEUS** (Fabricius).

A. G. Butler records a female of this form from the Rapids of the Drowned, Slave River, where it was collected July 1, 1892, by Miss Elizabeth Taylor.<sup>d</sup>

**PHYCIODES PRATENSIS** (Behr).

Fletcher has recorded this mountain species from the upper Liard River (latitude, 60°), where R. G. McConnell collected it, June 29, 1888.

<sup>a</sup> *Trans. Ent. Soc. Canada*, 3, 1903, p. 242.

<sup>b</sup> *Trans. Ent. Soc. Canada*, I, 1889, p. 636.

<sup>c</sup> *Trans. Ent. Soc. Canada*, new ser., Pt. 1, App. IV, (1889), p. 230 B.

<sup>d</sup> *Ibid.*, p. 230 B.

Doctor Fletcher informs me that the Canadian government collection also contains specimens from the vicinity of Dunvegan, Peace River, Athabaska, collected by J. M. Macoun in the summer of 1903.

POLYGONIA COMMA (Harris).

In the Fort Simpson collection which Edwards received from Mrs. Ross were several butterflies which he formerly referred to *comma*,<sup>a</sup> but later to the winter form *harrisii* (=syn. *comma*).<sup>b</sup> As there were no specimens representing the summer form *dryas*, Edwards concluded that the species is single-brooded in that latitude.

I can find no other records of occurrence.

POLYGONIA ZEPHYRUS (Edwards).

This western *Polygonia* is included in the present list solely on the strength of Edwards' Fort Simpson reference.<sup>c</sup> No further data are given, but the specimen is supposed to have been received by Edwards from Mrs. Ross. Fort Simpson is far north of the normal range of *P. zephyrus*, and recent collections from Mackenzie River localities have not contained it.

POLYGONIA FAUNUS (Edwards).

This butterfly seems to have a general distribution in Athabaska and southern Mackenzie. I noted it in 1903, as follows: Pierre au Calumet,<sup>d</sup> May 29, one; Smith Landing, June 12, two; Fort Resolution, June 23, two; delta of the Athabaska River, August 5, two; Pelican Rapid, Athabaska River, August 25, one. A single specimen was collected at Smith Landing, June 12. Mr. Preble collected another example at Fort Simpson, May 24, 1904.

Edwards records this species from Fort Simpson;<sup>e</sup> while Scudder mentions specimens from "Great Slave Lake," which are in the Museum of Comparative Zoology in Cambridge.<sup>f</sup>

POLYGONIA GRACILIS (Grote and Robinson).

I collected a specimen of this species at Fort Providence, July 3, 1903. It was taken at the flowers of the silverberry (*Elæagnus argentea*). Mr. Preble secured three specimens in 1904, one at each of following localities: Fort Simpson, April 24; Fort Good Hope, May 22; Fort McPherson, July 8.

<sup>a</sup> Butterflies of North America, I, 1879, [p. 102].

<sup>b</sup> Idem, III, 1897, [p. 171].

<sup>c</sup> Idem, I, 1879, [p. 125].

<sup>d</sup> On Athabaska River, 50 miles below Fort

<sup>e</sup> Butterflies of North America, I, 1879,

<sup>f</sup> Butterflies of Eastern United

A specimen from "Great Slave Lake" in the "Cambridge Museum" (Museum of Comparative Zoology) is mentioned by Scudder.<sup>a</sup> Strecker records a specimen from the "Athabaska region," obtained from Geffcken.<sup>b</sup> Francis A. Heron informs me that there is a specimen in the British Museum, collected at Great Slave Lake in July, 1894, by W. G. Cumming.

Although apparently of general distribution in the North, *P. gracilis* is nowhere common.

#### POLYGONIA PROGNE (Cramer).

This species was not taken by us in 1903-4. White records specimens taken by Richardson at Fort Simpson, and also on the "Arctic Coast between 67½° and 68°," in 1848.<sup>c</sup> Scudder<sup>d</sup> expresses doubt as to the Arctic coast specimens being *progne*, but makes no comment on the Fort Simpson record.

In more recent years Doctor Fletcher has recorded *progne* from Fort Simpson, where Frederick Bell collected two examples, July 12, 1888.<sup>e</sup> It has also been taken at Fort McLeod, British Columbia, and on Belly River, Alberta (Capt. Gamble Geddes).

#### EUGONIA J-ALBUM (Boisduval).

Two of these butterflies were seen on the Athabaska River, some 60 miles above the delta, August 6, 1903. A pile of freshly-cut spruce wood lying on the steamer apparently attracted the insects, as they flew about the deck as long as the boat was moored to the river bank. Both butterflies were in good condition, but eluded capture.

Scudder has the following note in regard to *E. j-album*: "Specimens labeled 'Arctic America, Ross,' may be seen in the British Museum, probably collected in the vicinity of Great Slave Lake."<sup>f</sup> I can find no further records for the Athabaska-Mackenzie region, but the species has been taken at various localities in the southern provinces. Apparently its range is restricted to the Canadian fauna.

#### EUVANESSA ANTIOPA (Linnæus).

The Mourning Cloak butterfly occurs commonly throughout the region as far north as Fort McPherson (latitude 67° 20'). I first collected it on July 4, 1903, at Fort Providence, where numbers were seen on the young growth of aspen (*Populus tremuloides*). On my

<sup>a</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 361.

<sup>b</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 132.

<sup>c</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 362.

<sup>d</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 369.

<sup>e</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 231 B.

<sup>f</sup> *Trans. Amer. Ent. Soc.*, vol. 1, 1889, p. 384.



outward trip two were noted at House River, Athabaska, August 21. Mr. Preble captured a specimen on Lake Hardisty, on the traverse between Fort Rae and Great Bear Lake, August 16, 1903. In 1904 he observed it at Fort Simpson, on April 17, and took two specimens at Fort Good Hope, June 21, and another at the mouth of Peel River, near Fort McPherson, July 1.

Strecker mentions a number of examples of *E. antiopa* from the "Athabaska region," received from Geffcken;<sup>a</sup> H. F. Wickham records several specimens taken by Frank Russell, of the University of Iowa, at Fort Rae in August, 1893;<sup>b</sup> while specimens collected by William Ogilvie on the Mackenzie River, 90 miles above Fort Good Hope, July 19, 1888, and at Fort Smith, August 24, 1888, have been recorded by Doctor Fletcher.<sup>c</sup>

#### AGLAIS MILBERTI (Godart).

This species was common at Fort Resolution, June 21 to 27, and at Fort Providence, July 4 to 8, 1903. It was usually observed feeding at the flowers of *Elæagnus argentea*. Three examples were taken.

*A. milberti* was collected at Fort Simpson as early as 1848, by Richardson;<sup>d</sup> Strecker received specimens from Geffcken which had been taken in the region between Hudson Bay and Lake Athabaska;<sup>e</sup> Scudder refers to specimens in the British Museum labeled "Arctic America, Ross";<sup>e</sup> eleven specimens were collected at Fort Simpson, June 26 to July 20, 1888, by Frederick Bell, and recorded by Doctor Fletcher;<sup>c</sup> while H. F. Wickham lists several which Frank Russell secured at Fort Rae, August 12, 1893.<sup>b</sup>

#### VANESSA ATALANTA (Linnæus).

This and the two preceding species are among the most characteristic butterflies of the Northland. *V. atalanta* was first noted June 9, 1903, near the confluence of Rivière de Rochers and Peace River. It was abundant at Fort Resolution, June 23 to 27, where it was chiefly noted on *Ribes* blossoms. At Fort Providence, July 3 to 8, it was feeding on both *Ribes* and *Elæagnus*. Several of these butterflies were also observed near House River, Athabaska, August 21. A specimen captured at the latter locality was perfectly fresh.

Although I found this species so common in 1903, it seems to have hitherto escaped observation in the region under review. It has been taken, however, in the region about Fort Churchill, Hudson Bay.

<sup>a</sup> Lepidoptera, Rhopaloceres and Heteroceres, 1872, p. 132.

<sup>b</sup> Explorations in the Far North, 1898, p. 276.

<sup>c</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, p. 10.

<sup>d</sup> White, in Arctic Searching Expedition, II, 1851, p. 10.

<sup>e</sup> Butterflies of Eastern United States and Canada, p. 10.

## VANESSA CARDUI (Linnæus).

This cosmopolitan butterfly is not absent from even the somewhat rigorous Northland. I first observed it June 16, 1903, on the Slave River, near the Grand Détour.<sup>a</sup> A few were seen at Fort Resolution, while at Fort Providence it was common, feeding on *Ribes* and *Eleagnus*.

There are several records for *V. cardui* in the southern provinces, and also in Alaska, but former observers in Athabaska and Mackenzie have not recorded it.

## BASILARCHIA ARTHEMIS (Drury).

This handsome butterfly was found by us only in the Mackenzie Basin. Several were noted at Fort Providence, July 4, and two at Fort Simpson, July 10, 1903; while in the region near the mouth of the North Nahanni River it was common from July 13 to 19 of the same year. I found this species in the alder thickets on Mount Thaoñ-tha, Nahanni Mountains, as high as 2,000 feet. Mr. Preble took a specimen in a poplar thicket near this mountain, July 25, 1904.

*B. arthemis* is a striking butterfly, and one of the most characteristic sights, as we "tracked" our canoe up the swiftly-flowing Nahanni, was the frequent glimpse of black and white as these butterflies flitted about in the dark green foliage of the alders which everywhere fringed the stream.

According to White this species was collected at Fort Simpson, and also on the "Borders of Mackenzie and Slave Rivers," by Richardson in 1848.<sup>b</sup> Edwards has the following in regard to it: "I formerly received a large invoice of butterflies collected by Mrs. Christina Ross at Fort Simpson, Mackenzie's River, and among them were many *arthemis*."<sup>c</sup> Geffcken had several examples from the Athabaska region, which he sent to Strecker.<sup>d</sup> Doctor Scudder has recorded specimens which the late Doctor Dawson, of the Canadian Geological Survey, collected at the Devil's Portage, Liard River.<sup>e</sup> Four others, collected at Fort Simpson in 1888 by Frederick Bell, are listed by Doctor Fletcher.<sup>f</sup> One of the latter specimens was recorded as *arthemis*, and three as belonging to the dimorphic form *lamina* Fabricius, which name has been dropped.<sup>g</sup> Specimens taken by Miss Elizabeth at Fort Simpson, July 9, and Fort Good Hope, July 18, 1892, were recorded by A. G. Butler.<sup>h</sup>

<sup>a</sup> Fort Smith, Mackenzie.

<sup>b</sup> *Proc. Acad. Nat. Sci. Phila.*, 2d ser., II, 1851, p. 362.

<sup>c</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1884 [p. 209].

<sup>d</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1884, p. 133.

<sup>e</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1889, p. 298.

<sup>f</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1889, p. 231B.

<sup>g</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1889, p. 25.

<sup>h</sup> *Proc. Acad. Nat. Sci. Phila.*, II, 1889, p. 25.

## CHLORIPPE, species.

A large species of *Chlorippe* was noted at Fort Chipewyan, June 4, 1903, but eluded capture. I had been hunting birds in a shady ravine on the main shore opposite English Island, and late in the afternoon noticed a dark insect flitting back and forth at intervals between a couple of willows which were running sap. Upon a near approach I found it to be a large *Chlorippe*, but further identification was impossible. The insect greatly resembled *C. clyton*.

*Chlorippe* is a southern genus, and has not previously been observed as far north as Athabaska.

## EREBIA FASCIATA (Butler).

Elwes has recorded several specimens which Mr. Hanbury collected in 1902 at the following Arctic coast localities: Chapman Island, June 27; Cape Barrow, June 30; Gray's Bay, July 1; Point Epworth, July 11.<sup>a</sup>

## EREBIA DISCOIDALIS (Kirby).

A common species in Athabaska and Mackenzie. I collected a specimen at Edmonton, Alberta, as early as May 10, 1903, and on June 12 two more at Smith Landing, Athabasca. In 1904, Mr. Preble found this butterfly at the following localities in the Mackenzie Basin: Fort Simpson, May 20; Fort Norman, June 13; Fort Good Hope, June 21 and 22.

Nearly all previous observers mention *discoidalis*. White records an *Erebia* taken by Richardson on the Arctic coast as follows: "*Hipparchia* n. s.! (near *H. discoidalis*), Kirby."<sup>b</sup> In 1863, Edwards received about twenty examples from Mrs. Christina Ross, all taken at Fort Simpson.<sup>c</sup> Strecker mentions over a hundred specimens in the collection he received from Geffcken, said to have been collected in the "Athabasca region."<sup>d</sup> Frederick Bell collected specimens at Fort Simpson in 1888, according to Doctor Fletcher.<sup>e</sup>

This is the common *Erebia* in the forested region, being replaced on the Barren Grounds by several other species. Kirby based his description of *discoidalis* upon specimens from Cumberland House, Saskatchewan (latitude 54°).

<sup>a</sup>Trans. Ent. Soc. London, Pt. 3, 1903, p. 239.

<sup>b</sup>Arctic Searching Expedition, II, 1851, p. 362.

<sup>c</sup>Butterflies of North America, III, 1897 [p. 255].

<sup>d</sup>Lepidoptera, Rhopaloceres and Heteroceres, 1872, p. 132.

<sup>e</sup>Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 231B.

**EREBIA ROSSII** (Curtis).

This beautiful Arctic species, the type of which came from Boothia Felix, seems to have been taken in Mackenzie by only two collectors. White records it from the "Arctic Coast between  $67\frac{1}{2}^{\circ}$  and  $68^{\circ}$ ," where Richardson collected it in 1848;<sup>a</sup> while Elwes records three specimens taken by the Hanbury expedition—a pair on the Barren Grounds ( $114^{\circ}$  W.,  $67^{\circ} 40'$  N.), July 14, and one at Point Epworth, July 11, 1902.<sup>b</sup>

**EREBIA DISA** Thunberg.

Three males and a female were collected by Mr. Hanbury at Point Epworth, July 11, 1902. Elwes considers them to be much nearer specimens of *E. disa* from Finland than to our var. *manicinus* from Alaska.<sup>c</sup>

**EREBIA YOUNGI** Holland.

Mr. Preble collected two specimens at Fort McPherson, July 8, 1904, thus extending the range of this species east of the Rocky Mountains. These examples differ in no respect from Alaska specimens of *youngi*.

**EREBIA EPIPSODEA** (Butler).

Doctor Fletcher informs me that the Canadian government collection at Ottawa contains this species from the vicinity of Dunvegan, Peace River, Athabaska, where J. M. Macoun collected specimens in the summer of 1903.

*E. epipsodea* is a mountain species, and probably occurs over most of western Athabaska.

**COENONYMPHA OCHRACEA** (Edwards).

This dainty little butterfly was common at Fort Providence from July 3 to 8, 1903, where, on bright mornings, numbers could be seen flitting about on the open rocky hillside near the river. I easily collected a good series of both sexes. Nearly all were perfectly fresh, indicating that the species had not been flying many days at that point.

*C. ochracea* has previously been recorded from Red Deer River, Alberta, but apparently from no farther north.

**COENONYMPHA TIPHON** var. **MIXTURATA** Alpheraky.

Elwes considers two males and a female taken by Hanbury on Dismal Creek (Kendall River), east of Great Bear Lake, July 30, 1902, as most closely approaching the Kamchatkan form.<sup>d</sup>

<sup>a</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>b</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 240.

<sup>c</sup> Idem, p. 239.

<sup>d</sup> Idem, p. 241.



## SATYRODES CANTHUS (Linnæus).

I observed this butterfly but once, at Smith Landing, Athabaska, June 12, 1903. Apparently rare in the north.

Scudder mentions specimens from the vicinity of Great Slave Lake.<sup>a</sup>

## CENEIS CHRYXUS Doubleday and Hewitson.

One example from the Nahanni Mountains, July 16, 1903. It was taken on a rock slide, together with two or three other species of *Oeneis*. Mr. Preble captured a female at Fort Good Hope, June 23, 1904.

*O. chryxus* is more common in the southern and eastern provinces.

## CENEIS JUTTA (Hübner).

I collected three specimens on a rock slide in the Nahanni Mountains, July 16, 1903. Doctor Dyar considers them intermediate in coloration between normal *jutta* and var. *alaskensis* Holland.

Doctor Strecker mentions specimens from the "Athabasca region," which he received from Herr Geffcken, of Stuttgart, Germany.<sup>a</sup>

Like the preceding species, *jutta* seems to be more abundant in the southern and eastern provinces, although its range is undoubtedly continuous, connecting with that of var. *alaskensis* on the northwest.

## CENEIS BORE (Hübner).

According to Butler, Miss Elizabeth Taylor collected this species at the Rapids of the Drowned, Slave River, June 28, 1892.<sup>b</sup>

## CENEIS TAYGETE (Hübner).

Three examples were collected at Fort McPherson, July 8, 1904, by Edward A. Preble.

Richardson collected a pair of these butterflies on the "Arctic Coast between 67½° and 68°," which White records as *Chionobas bore* Boisd.<sup>c</sup> A small series of *taygete*, comprising five males and three females, was taken by Hanbury at Gray's Bay, Point Epworth, and on the Barren Grounds to the westward of Point Epworth, early in July, 1902. These specimens have been listed by Elwes.<sup>d</sup>

This variety has been taken in Alaska, and is common in portions of Labrador, apparently inhabiting the tundra regions only.

## CENEIS SUBHYALINA (Curtis).

I captured a single specimen in the Nahanni Mountains, July 13, 1903.

<sup>a</sup> Butterflies of Eastern United States and Canada, I, 1889, p. 198.

<sup>b</sup> Annals Nat. Hist. (6), XII, 1893, p. 12.

<sup>c</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>d</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 240.

## CENEIS SEMIDEA(?) (Say).

Five specimens from the Barren Grounds and one from Point Epworth, taken by Hanbury, are referred by Mr. Elwes to either *semidea*, or *crambis* Freyer, but not closely approaching either.<sup>a</sup> *Crambis* is given as a synonym of *subhyalina* by Dyar.<sup>b</sup>

## CENEIS CARYI Dyar.

The type of this new variety, a male in beautiful condition, was taken June 13, 1903, in an open growth of Banksian pine (*Pinus divaricata*) on the Smith Portage, Athabaska.

*Caryi* is a form of *norna*, and differs from that species, as well as from var. *katahdin* Newcomb, in having the red color of the wings much darker and more rusty.

## CENEIS NAHANNI Dyar.

The type of this well characterized species came from Nahanni Mountains, Mackenzie. The pair from which it has been described was collected on Mount Tha-on'-tha, Nahanni Mountains, Mackenzie, July 16, 1903, at 2,500 feet altitude.

Butterflies of this genus were fairly common on the north slope of the mountain, occurring chiefly among the rock slides. It would be impossible to say which species predominated, as I was occupied with miscellaneous collecting, and merely caught lepidoptera as occasion offered. There is no distinguishing of species on the wing with butterflies of this genus. One habit all shared alike—that of “sneaking,” i. e., crawling and half flitting about on the rock piles until a convenient crack or crevice afforded them concealment. This was almost invariably done immediately after the insect alighted. I found them very difficult to flush, and when a butterfly did take to the air the flight seldom was sustained for more than a rod.

*O. nahanni* differs in color from *uhleri* Reakirt, and the markings and striations below are much coarser than in the forms of *norna* Thunberg. I can do no better than quote the characterization from the original description:<sup>c</sup>

Blackish above, washed with ferruginous brown, the veins darker, the markings of underside showing. A small ocellus or none above vein five, on fore wings, two to five on hind wings, the one above vein five largest, the rest small or absent. Hind wings below black and white, coarsely strigose, somewhat as in *uhleri* Reakirt, and *varuna* Edwards, but much more densely, the white of the wing being largely obscured. Median band weakly indicated; ocelli black with white pupils; fore wings shaded with red over the disk.

<sup>a</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 240.

<sup>b</sup> List N. Am. Lep., Bull. No. 52, U. S. Nat. Mus., 1902, p. 31.

<sup>c</sup> Proc. Ent. Soc. Wash., VI, 1904, p. 142.

## ANOSIA PLEXIPPUS (Linnæus).

I saw one of these butterflies in the poplar forest back of Fort Providence, July 3, 1903, but did not capture it.

This common species seems to be rare in the north, as no previous observers have recorded it from Mackenzie. Scudder records it from the "Athabasca country" on the authority of Geffcken,<sup>a</sup> but it is not mentioned by Strecker in his list of the northern collection which he received from Geffcken.<sup>b</sup>

*A. plexippus* occurs in portions of Alaska, and is common in the southern provinces of Canada.

## INCISALIA IROIDES (Boisduval).

A common butterfly in the forest region. I took five at Fort Chipewyan, Athabaska, June 3, 1903, and others on the Smith Portage, June 13. In 1904, Mr. Preble secured a specimen at Fort Good Hope, June 22. Apparently it has been overlooked by former observers in the Athabaska-Mackenzie region.

In Alberta the species was taken at Edmonton, and observed along the Athabaska trail between that point and Athabaska Landing. It was flying abundantly in a forest of Banksian pine along Towattinow Creek, some 20 miles south of the Landing, May 14, 1903.

## EPIDEMIA DORCAS (Kirby).

Apparently uncommon. One was seen at Fort Chipewyan, June 3, 1903, and a fresh specimen taken in the Nahanni Mountains, July 13.

*E. dorcas* occurs in the southern provinces, and also in Alaska. The type locality is Cumberland House, Saskatchewan (latitude 54°).

## CUPIDO SÆPIOLUS (Boisduval).

Several were seen July 1, 1903, in a marsh bordering Great Slave Lake, near Hay River post. At Fort Providence, a little later in the month, *sæpiolus* was common in an open pasture just back of the Catholic Mission. Four males were taken, two at each locality. Mr. Preble collected another male example near the mouth of the North Nahanni River, July 25, 1904.

Doctor Fletcher has recorded this species from the Devil's Portage, Liard River (126° 10' W.), where R. G. McConnell, of the Canadian Geological Survey, secured specimens in 1888.<sup>c</sup>

<sup>a</sup> Butterflies of Eastern United States and Canada, I, 1889, p. 728.

<sup>b</sup> Lepidoptera, Rhopaloceres and Heteroceres, 1872, p. 132.

<sup>c</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 231 B.

## CUPIDO AMICA (Edwards).

The type of this species came from "Mackenzie's River."

Not recorded by recent observers. The type was received by Edwards from Mrs. Ross, who collected it at some point on the Mackenzie River.<sup>a</sup>

## NOMIADES COUPERII (Grote).

This is a common species in the region between Fort Chipewyan and Fort Good Hope. It was feeding at *Fragaria* blossoms on the Smith Portage, and also frequented damp situations and mud holes along the trail. Specimens were taken in 1903 at Fort Chipewyan, Smith Landing, Fort Resolution, and Hay River, both sexes being represented in the series. Mr. Preble collected three examples at Fort Good Hope, June 21, 1904.

A. G. Butler has recorded this species from the "Athabasca River," where Miss Elizabeth Taylor collected it June 5, 1892.<sup>b</sup>

## AGRIADES PODARCE (Felder).

This exquisite little species was quite common on the exposures of Archæan rock near Smith Landing, Athabaska, where I collected a fine series of both sexes in perfect condition, June 11 and 12, 1903. When flushed the flight is weak and low, rarely more than six inches above the rock. Unlike most species of the genus, *podarce* feels safe only when on the rocks, where it hides most effectually in the short moss. It is easily overlooked unless sought for, and when on bare rock its detection is almost an impossibility. I often had two or three flush at my feet after having endeavored ineffectually for some time to beat them up. Whenever a passing cloud obscured the sun these butterflies could not be forced to take wing.

The only previous record for the Athabaska-Mackenzie region seems to be that of Butler,<sup>b</sup> who records specimens taken by Miss Elizabeth Taylor at the Rapids of the Drowned, Slave River, July 1, 1892. Miss Taylor's locality is but a very few miles from Smith Landing. The range of *A. podarce* thus appears to be very local.

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<sup>a</sup>In his original description of *amica* Edwards says he received the species from "Mackenzie's River by Mrs. Ross." In the synopsis of North American butterflies at the end of his first volume (Butt. N. Am., 1879, I) Edwards gives the type locality as "Fort Ross, Mackenzie's River." There is no such post as Fort Ross at the present time, nor can I find any reference to it. Edwards probably referred to Fort Simpson, where B. R. Ross was located for many years as factor.

<sup>b</sup>Annals Nat. Hist. (6), XII, 1893, p. 13.



## AGRIADES AQUILO (Boisduval).

Under the name "*Polyommatus franklinii*" White records specimens which Richardson collected on the Arctic coast of western Mackenzie in 1848.<sup>a</sup> Mr. Hanbury collected a pair on the Barren Grounds (140° W., 67° 40' N.), in 1902, which Elwes refers to *Lycæna orbitulus* var. *franklinii* Curtis.<sup>b</sup> According to Doctor Dyar *franklinii* Curtis and *aquilo* Boisduval are synonymous.<sup>c</sup>

## CYANIRIS LADON var. LUCIA (Kirby).

There seems to be but one record for this form of *ladon* in the Athabaska-Mackenzie region, although its distribution should be general throughout the forested region. Doctor Fletcher records a single example collected by Frederick Bell at Fort Simpson, June 25, 1888.<sup>d</sup> All of the specimens of *ladon* secured by Mr. Preble and myself seem to be referable to the form Doctor Fletcher has recently described as var. *nigrescens*, from Kaslo, Kootenay Lake, British Columbia.<sup>e</sup>

## CYANIRIS LADON var. NIGRESCENS Fletcher.

I captured a male of this form near the Grand Détour, Slave River, Athabaska, June 16, 1903. In the lower Mackenzie Basin Mr. Preble took specimens in 1904, as follows: Fort Norman, June 12, one example; Fort Good Hope, June 21 to 23, ten; Fort McPherson, July 6 to 8, two.

In Alberta, I collected a male at Edmonton, May 10, and four males at Vermillion River, May 13, 1903, all in perfect condition.

## EVERES COMYNTAS (Godart).

This species was not uncommon in Athabaska and southern Mackenzie in 1903. Specimens were collected as follows: Smith Landing, June 12, two males; Fort Resolution, June 24 to 26, four males; Fort Providence, July 8, one male.

Scudder refers to specimens in the British Museum, labeled "Arctic America, R. B. Ross."<sup>f</sup> These specimens probably were received from Fort Simpson through B. R. Ross. Butler mentions specimens collected by Miss Elizabeth Taylor at the Rapids of the Drowned, Slave River, June 29, 1892.<sup>g</sup>

*E. comyntas* was usually observed at the flowers of *Fragaria*, *Potentilla*, and other low-flowering plants.

<sup>a</sup> Arctic Searching Expedition, II, 1851, p. 362.

<sup>b</sup> Trans. Ent. Soc. London, Pt. 3, 1903, p. 242.

<sup>c</sup> List N. Am. Lep., Bull. No. 52, U. S. Nat. Mus., 1902, p. 44.

<sup>d</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 231 B.

<sup>e</sup> Trans. Roy. Soc. Canada, Sec. IV, 1903, p. 213.

<sup>f</sup> Butterflies of Eastern United States and Canada, II, 1889, p. 914.

<sup>g</sup> Annals Nat. Hist. (6), XII, 1893, p. 13.

**EVERES AMYNTULA (Boisduval).**

Doctor Fletcher has recorded this species from the Devil's Portage, Liard River (longitude  $126^{\circ} 10'$ ), where R. G. McConnell, of the Canadian Geological Survey, collected it on July 17, 1888.<sup>a</sup>

**RUSTICUS SCUDDERI (Edwards).**

I can find but two records of the capture of this species in the region under review. A. G. Butler records three male specimens in the British Museum, which were collected by Miss Elizabeth Taylor on the east bank of the Mackenzie River, 30 miles north of the Arctic Circle, July 18, 1892.<sup>b</sup> Specimens secured in the vicinity of Dunvegan, Peace River, Athabaska, by J. M. Macoun, in the summer of 1903, have been determined by Doctor Fletcher, and are in the Canadian government collections at Ottawa.

**RUSTICUS MELISSA (Edwards).**

Dr. James Fletcher, of Ottawa, informs me that there are specimens of this species in the Canadian government collections under his charge, collected by J. M. Macoun in the summer of 1903, near Dunvegan, Athabaska.

**PAMPHILA PALÆMON (Pallas).**

I found this diminutive species only at Fort Providence. Several individuals were seen among the sedges in a tamarack muskeg, and one captured, July 4, 1903. This "skipper" is very easily overlooked, because of its small size.

*P. palæmon* has been taken at Banff and Lacombe, Alberta,<sup>c</sup> and has a wide range in the southern provinces.

**ERYNNIS COMMA (Linnæus).**

Two specimens in good condition were collected on the summit of Mount Tha-on'-tha, Nahanni Mountains, July 16, 1903. Not observed elsewhere, nor are there previous records of its capture in the Athabaska-Mackenzie region.

**ERYNNIS COMMA var. MANITOBA Scudder.**

Francis A. Heron, of the British Museum, writes me that Miss Taylor's specimens from Slave River, which Butler has recorded as *E. colorado*,<sup>d</sup> are more properly referable to the present form. These specimens, a pair, were taken at the Rapids of the Drowned, Slave River, June 29 and 30, 1892.

<sup>a</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 231 B.

<sup>b</sup> Annals Nat. Hist. (6), XII, 1893, p. 13.

<sup>c</sup> Can. Ent., XXXIII, 1901, p. 171.

<sup>d</sup> Annals Nat. Hist. (6), XII, 1893, p. 14.

## THORYBES PYLADES (Scudder).

A common butterfly along the Smith Portage, Athabaska, but observed nowhere else in the north. Five specimens, Smith Portage and Fort Smith, June 12 to 14, 1903, were taken about mudholes along the trail.

## THANAOS ICELUS Lintner.

This familiar "skipper" was not uncommon on the Smith Portage, Athabaska, where it was taken with the preceding species. A number were also secured at Fort Resolution late in June, and Mr. Preble took two specimens at Fort Norman, June 10, 1904.

Specimens collected at Fort Simpson, June 26, 1888, by Frederick Bell, have been recorded by Doctor Fletcher.<sup>a</sup>

## THANAOS PROPERTIUS var. BOREALIS, new variety.

Genital armature similar to that of *propertius*; tip of right piece long and finger-shaped. Wings more heavily clouded with dusky, and light spots reduced to a minimum; hoary gray on fore wings largely restricted to outer third. Transverse series of four light spots near costal margin on apical portion of primaries small, punctiform, distinct; rest of light spots obsolete. Marginal and submarginal series of spots on under surface of secondaries showing faintly on upper surface.

One male, mouth North Nahanni River, Mackenzie, June 4, 1904. Edward A. Preble.

*Type*.—No. 9869, U.S.N.M.

This is a small, dark, boreal variety of the common *T. propertius* of the northern Pacific coast region of the United States, and is based upon a male specimen in fairly good condition.

## THANAOS MARTIALIS (Scudder).

In his review of Miss Elizabeth Taylor's northern collection, A. G. Butler records this species from the Rapids of the Drowned, Slave River, June 29, 1892.<sup>b</sup>

## HESPERIA CÆSPITALIS (Boisduval).

Early in July, 1903, I saw a number of these butterflies on the rocky bank of the Mackenzie River at Fort Providence, but found them exceedingly difficult to capture. Two fresh examples were taken—Smith Portage, June 12, and Fort Providence, July 5, 1903.

Although common in Alberta, *H. cæspitalis* has not heretofore been recorded from the Athabaska-Mackenzie region.

<sup>a</sup> Ann. Rept. Can. Geol. Surv., III (new ser.), Pt. 1, App. IV, (1889), p. 231 B.

<sup>b</sup> Annals Nat. Hist. (6), XII, 1893, p. 14.

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# LIST OF FISHES COLLECTED IN JAPAN IN 1903, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

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By HUGH M. SMITH and THOMAS E. B. POPE,

*Of the U. S. Bureau of Fisheries.*

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During a brief visit to Japan in 1903 the senior author obtained a small collection of fresh-water and marine fishes from various points on the islands of Hondo, Shikoku, and Kiushiu. Having only limited facilities for preserving specimens, he was obliged to confine the collection to the smaller forms; and not being provided with a seine or other net he depended largely on the markets and on the services of local fishermen.

The principal localities from which specimens were obtained were (1) Matsushima Bay, from the fishery experiment station at Shiogama, where a number of interesting specimens were secured from the station museum; (2) Hamashima, province of Shima, from the collection of the fishery station at that place; (3) the Inland Sea in the vicinity of Onomichi; (4) Kochi and Urado, in the province of Tosa; (5) Susaki, in the same province, where there is a fishery experiment station; (6) Kagoshima, province of Satsuma; (7) Yamagawa, at the mouth of Kagoshima Bay; (8) Nigara River at Gifu; (9) Lake Biwa, near its outlet; and (10) Sendai River at Sendai, province of Satsuma.

For cooperation and active aid in making the collection, acknowledgment is due to Dr. K. Kishinouye, Dr. T. Kitahara, Dr. T. Nishikawa, Dr. K. Oku, and Dr. T. Nishimura, all of the Imperial Fisheries Bureau; their excellencies, Governor Watanabe and Governor Kawaji, of the prefectures of Kochi and Gifu; the director of the fishery experiment station at Shiogama; Mr. J. Shobu, of the fishery experiment station at Hamashima; Mr. I. Shishido, of the Imperial University at Kyoto; Mr. Y. Hosokawa, president of the Fishermen's Association of Kochi prefecture, and Mr. Y. Kida, of the Kochi Middle School; Mr. H. Niwa, director of the fishery experiment station at Susaki, Tosa; Mr. T. Sakai, of the imperial biological station at Onomichi; Mr. Yoshio Asahara, director of the fishery experiment station of Kagoshima prefecture; Mr. S. Machida, of Kagoshima, and

Mr. K. Nomaguchi, mayor of Yamagawa, as well as to numerous other officials of the various prefectures.

For assistance and suggestions in studying this collection we acknowledge our indebtedness to Dr. D. S. Jordan, Dr. B. W. Evermann, Dr. Theodore Gill, and Mr. Alvin Seale.

The extensive writings of Dr. David Starr Jordan and his associates descriptive of the fish fauna of Japan have made comparatively easy the identification of this collection. That the waters of Japan still hold many undiscovered ichthyological treasures can not be doubted, however, notwithstanding the large amount of matter which has within the past few years been added to the already very considerable literature of Japanese fishes; for the present collection, made quite incidentally, limited to specimens most easily preserved, and representing little more than the forms found here and there in the markets, contains one new family (Caristiidae), five new genera, and eleven new species, in addition to several species not previously known from Japan. In this last class are *Embolichthys mitsukurii* (Jordan and Evermann), described from Formosa; *Nealotus tripes* Johnson, not previously known from the Pacific Ocean; *Terapon jarbua* (Forskål); *Peristedion rieffeli* Kaup; and *Eleotriodes heldsdingenii* Bleeker.

The local names of the fishes in the localities where collecting was done have been supplied wherever known.

### Family CARCHARIIDÆ.

#### TYPICAL SHARKS.

#### 1. MUSTELUS MANAZO Bleeker.

##### KOSHINAGABUKA.

Kochi, May 7, one specimen, 324 mm. long.

### Family RAJIDÆ.

#### SKATES.

#### 2. RAJA MEERDEVOORTI Bleeker.

##### YEI; KUROSU.

Kochi, May 7, one specimen, 267 mm. long; Kagoshima, June 16, one specimen, 203 mm. long, 50 fathoms, rare.

### Family DASYATIDÆ.

#### STING-RAYS.

#### 3. UROLOPHUS FUSCUS Garman.

Kagoshima, June 16, two specimens, 120 and 200 mm. long.

### Family PLOTOSIDÆ.

#### SEA CATFISHES.

#### 4. PLOTOSUS ANGUILLARIS Lacépède.

Kagoshima, June 16, two specimens, 197 and 215 mm. long.



## Family SILURIDÆ.

## COMMON CATFISHES.

## 5. FLUVIDRACO RANSONNETII (Steindachner).

Kochi, May 7, one specimen, 95 mm. long.

## Family COBITIDÆ.

## LOACHES.

## 6. COBITIS TÆNIA Linnæus.

Setagawa, Lake Biwa, April 22, two specimens, 85 and 94 mm. long.

## Family CYPRINIDÆ.

## MINNOWS AND CARPS.

## 7. ACHEILOGNATHUS LANCEOLATA (Temminck and Schlegel).

Setagawa, Lake Biwa, April 22, two specimens, 63 and 65 mm. long.

## 8. LEUCOGOBIO BIWÆ (Jordan and Snyder).

Setagawa, Lake Biwa, April 22, 1 specimen, 52 mm. long.

## 9. SARCOCHEILICHTHYS VARIEGATUS (Temminck and Schlegel).

## HIGAI.

Setagawa, Lake Biwa, April 22, four specimens. A female 152 mm. long, in spawning condition, has a black bar across dorsal most distinct anteriorly, anal and ventrals plain, pectorals dusky. A male 178 mm. long, with nuptial tubercles on head, has no distinct bar on dorsal; anal, ventrals, and pectorals black-tipped. A young male 92 mm. long, with tubercles on head, has a rather distinct bar on dorsal; anal, ventrals, and pectorals black-tipped. A specimen 54 mm. long has fins plain, and a distinct blackish lateral stripe.

## 10. BIWIA ZEZEKA (Ishikawa).

## ENDUSO; URORE.

Setagawa, Lake Biwa, April 22, four specimens, 55 to 65 mm. long.

## 11. PSEUDORASBORA PARVA (Temminck and Schlegel).

## MOROKO.

Setagawa, Lake Biwa, April 22, four specimens, 42 to 83 mm. long.

## 12. OTAKIA RASBORINA Jordan and Snyder.

Setagawa, Lake Biwa, April 22, one specimen, 115 mm. long.

## 13. LEUCISCUS HAKUENSIS Günther.

## NIGOI.

Sendaigawa at Sendai, Kiushiu, June 10, one specimen, 265 mm. long.

14. *ZACCO PLATYPUS* (Temminck and Schlegel).  
HAYE.

Setagawa, Lake Biwa, April 22, one specimen, 116 mm. long; Urado, May 7, one specimen, 130 mm. long; Sendaigawa at Sendai, Kiushiu, June 10, one specimen, 128 mm. long.

15. *ISCHIKAUIA STEENACKERI* (Sauvage).  
WATAKA.

Setagawa, Lake Biwa, April 22, 1 specimen, 138 mm. long.

Family *LEPTOCEPHALIDÆ*.  
CONGER EELS.

16. *LEPTOCEPHALUS NYSTROMI* Jordan and Snyder.

Kagoshima, June 16, one specimen, 226 mm. long.

Family *MURÆNESOCIDÆ*.

17. *MURÆNESOX CINEREUS* (Forskål).  
HAMU.

Kochi, May 7, one specimen, 480 mm. long. Origin of dorsal slightly in advance of pectoral.

Family *CLUPEIDÆ*.  
SHADS AND HERRINGS.

18. *STOLEPHORUS JAPONICUS* (Houttuyn).  
OKINIROGI.

Susaki, May 8, two specimens, 78 and 80 mm. long.

Family *DOROSOMATIDÆ*.  
GIZZARD SHADS.

19. *KONOSIRUS PUNCTATUS* (Temminck and Schlegel).  
DOROKUI.

Urado, near Kochi, May 7, one specimen, 157 mm. long.

20. *KONOSIRUS NASUS* (Bloch).  
DOROKUI.

Urado, May 7, three specimens, 130 to 182 mm. long. These and the foregoing caught in the interesting cast-net fishery.

Family *ENGRAULIDÆ*.  
ANCHOVIES.

21. *ANCHOVIA JAPONICA* (Temminck and Schlegel).

Susaki, Tosa, May 8, one specimen, 65 mm. long.

## Family ARGENTINIDÆ.

SMELTS.

22. *OSMERUS DENTEX* Steindachner.

Matsushima Bay, one specimen, 58 mm. long; from Fishery Experiment Station, Shiogama.

## Family SALMONIDÆ.

SALMONS AND TROUTS.

23. *PLECOGLOSSUS ALTIVELIS* Temminck and Schlegel.

AYU.

Nigara River at Gifu. Several specimens caught by cormorants.

## Family SYNODONTIDÆ.

LIZARD-FISHES.

24. *TRACHINOCEPHALUS MYOPS* (Forster).

GONAYESO.

Kochi, May 7, one specimen, 117 mm. long.

25. *SYNODUS VARIUS* (Lacépède).

SUZUME.

Kochi, May 7, one specimen, 132 mm. long; May 11, one specimen, 305 mm. long; Urado, May 10, one specimen, 134 mm. long; Yamagawa, June 16, one specimen, 86 mm. long. The specimen from Yamagawa has the markings very distinct, the irregular bands meeting across the back.

26. *SAURIDA JAPONICA* Houttuyn.

YESO.

Kochi, May 7, one specimen, 195 mm. long; Yamagawa, June 14, two specimens, 182 and 145 mm. long.

## Family SYNGNATHIDÆ.

PIPE-FISHES.

27. *SYNGNATHUS SCHLEGELI* Kaup.

Matsushima Bay, one specimen, 138 mm. long; from Fishery Experiment Station, Shiogama.

## Family AULORHYNCHIDÆ.

28. *AULICHTHYS JAPONICUS* Brevoort.

Matsushima Bay, two specimens, 90 and 142 mm. long; from Fishery Experiment Station, Shiogama.

Family FISTULARIIDÆ.  
TRUMPET-FISHES.

29. FISTULARIA DEPRESSA Günther.

Near Yamagawa, June 16, three specimens, 150, 150, and 187 mm. long.

Family SPHYRÆNIDÆ.  
BARRACUDAS.

30. SPHYRÆNA JAPONICA Cuvier and Valenciennes.

Yamagawa, June 14, one specimen, 105 mm. long; June 16, two specimens, 58 mm. long.

Family ATHERINIDÆ.  
SILVERSIDES.

31. ATHERINA BLEEKERI Günther.

Matsushima Bay, one specimen, 113 mm. long; from Fishery Experiment Station, Shiogama.

32. ATHERINA TSURUGÆ Jordan and Starks.  
TONGORO.

Susaki, May 8, two specimens, 120 and 123 mm. long.

Family TRACHICHTHYIDÆ.  
DEEP-SEA BERYCIDS.

33. HOPLOSTETHUS MEDITERRANEUS Cuvier and Valenciennes.

Kagoshima, June 12, two specimens, 63 and 70 mm. long; June 16, two specimens, 60 and 101 mm. long.

Family HOLOCENTRIDÆ.  
SQUIRREL-FISHES.

34. OSTICHTHYS JAPONICUS (Cuvier and Valenciennes).

Kochi, May 7, one specimen, 114 mm. long. A beautiful crimson fish, the color deepest on back and peduncle; bluish stripes along scales on back and sides; first dorsal uniform crimson, with a narrow black edge.

Family SCOMBRIDÆ.  
MACKERELS.

35. SARDA ORIENTALIS (Temminck and Schlegel).

Urado, May 10, one young specimen, 77 mm. long, doubtless referable to this species; head 2.8, depth 4.25; eye 4; snout 2.25; maxillary reaching to posterior margin of eye, 1.5 in head; depth of caudal peduncle less than 0.5 eye; gill-rakers short, 12 to 15 on lower limb;



dorsal xv-1, 12-7; anal v, 10-6; caudal small, deeply forked, the lobes not widely flaring; lateral line sinuous; color pale reddish brown, with about five dusky cross bands.

Family GEMPYLIDÆ.

36. *NEALOTUS TRIPES* Johnson.

Hamashima, offshore, October 8, 1902, one specimen, 240 mm. long; from Hamashima Fishery Station. This specimen is the size of the type and agrees very closely with Johnson's original description. Depth 7.3 to base of caudal, about 8.3 to end of caudal; head 3.75; eye 1.6 in snout, 4.3 in head; dorsal xxi, 19-2; anal i-8-3. Front of upper jaw with 6 fang-like teeth 0.5 length of eye; posterior to these about 12 partly concealed, widely separated sharp-pointed teeth on the dental ridge; teeth in lower jaw sharp, compressed, much larger than the lateral teeth in upper jaw, about 10 on each side. Color, apparently silvery, underlaid with brown.



FIG. 1.—*NEALOTUS TRIPES*.

Günther<sup>a</sup> gives the following history of this interesting species, of which the Japanese specimen is the third that has been taken:

This fish was known from a single example, 10 inches long, obtained at Madeira in the month of December [1864], and has been fully described by Johnson, who says that his specimen has been deposited in the British Museum. Such was undoubtedly his intention when he wrote his description, as before and afterwards he most liberally presented his ichthyological treasures to the national institution. But this specimen was never received, and from later inquiries it would appear that this valuable type is lost. The *Challenger* collection contains a very young specimen, only 33 mm. long, which agrees so well with Johnson's description that it doubtless belongs to the same species. Only the dagger-shaped postanal spine is shorter than the ventral spines, and also the separation of distinct finlets can not be clearly made out, as might be expected in so young an example. It was brought up in the dredge at Station 40, in latitude 34° 51' north, longitude 68° 30' west, where the dredge reached a depth of 2,675 fathoms. \* \* \* It is \* \* \* probable that this small fish entered the dredge shortly before it came to the surface.

Family CARANGIDÆ.

*CREVALLES, POMFANOS, ETC.*

37. *DECAPTERUS RUSSELLI* (Rüppell).

*AOAJI.*

Susaki, May 8, one specimen, 146 mm. long.

<sup>a</sup> Deep-sea Fishes, Voyage of the *Challenger*, XXII, 1887.

38. *TRACHURUS JAPONICUS* Temminck and Schlegel.

Shore near Yamagawa, June 16, one specimen, 92 mm. long.

39. *CARANGUS EQUULA* (Temminck and Schlegel.)

SHIMAJI.

Kochi, May 7, one specimen, 225 mm. long. Head 3.2, depth 2.16, eye 3.33, snout 3; dorsal VIII-1, 25; anal II-1, 24; scutes about 35; 8 or 9 obsolete dark, narrow vertical bands on back and sides; dorsal and anal fins with white margins, light green at base, and blackish between; ventrals silky white.

## Family SCOMBROPIDÆ.

40. *SCOMBROPS BOOPS* (Houttuyn).

SHIRAGENNAI (Susaki).

Susaki, May 8, one specimen, 100 mm. long; Kagoshima and Yamagawa, shore, June 10 and 16, three specimens, 88 to 111 mm. long.

## Family LEIOGNATHIDÆ.

41. *LEIOGNATHUS ARGENTATUS* Houttuyn.

NIROGI.

(*Equula nuchalis* TEMMINCK and SCHLEGEL.)

Kochi, May 7, three specimens, 73 to 80 mm. long.

42. *LEIOGNATHUS RIVULATUS* (Temminck and Schlegel).

KIBINAGO.

Susaki, May 8, one specimen, 75 mm. long.

43. *LEIOGNATHUS ELONGATUS* Smith and Pope, new species.

Head 3.75; depth 3.75; eye 3.25; snout 3.25; dorsal VIII, 16; anal III, 14.

Body very elongate and moderately compressed, its depth not greater than length of head; dorsal and ventral profiles about evenly curved and tapering gently to the very short and slender peduncle; caudal peduncle about 0.66 diameter of eye; head acute, the upper surface weakly convex, the sides compressed to form a very narrow surface on the ventral side; mandibular but slightly concave; eye of moderate size, its diameter equal to snout; interorbital equal to eye, with a median ridge from snout to occiput and supraocular ridges inclosing triangular space; lower preopercular margin with very fine serrations; scales small, cycloid, deciduous; opercles naked, cheeks scaly; lateral line conspicuous, with about 42 tubular pores; second and third dorsal spines longest, 1.75 in depth of body and 2 in distance from origin of fin to anterior margin of eye; longest anal spine (second) less than 0.5

head; caudal deeply forked; pectorals 1.5 in head; ventrals somewhat less than 2 in head.

Color in alcohol: Yellowish-brown above, with purplish tinge below that may have been silvery in life; scales everywhere covered with fine black punctulations which are larger and more scattered on lower side of head and body; back and sides marked with a number of irregular dark purplish spots and vermiculations; a black spot at base of each dorsal and anal ray; axil of pectoral black; posterior edge of gill



FIG. 2.—*LEIOGNATHUS ELONGATUS*. (From the type.)

cavity black, showing through opercular flap; a short black band on tip of snout above mouth; fins without definite color markings.

Described from a specimen 90 mm. long from Kagoshima, collected June 16, 1903, by H. M. Smith.

*Type*.—Cat. No. 55613, U.S.N.M.

This species may be easily recognized by its elongate form and mottled coloration.

#### Family STROMATEIDÆ.

BUTTER-FISHES.

##### 44. *PSENOPSIS ANOMALUS* (Temminck and Schlegel.)

Matsushima Bay, one specimen 178 mm. long; from Fishery Experiment Station, Shiogama. Head 4, depth 2.5, eye 3.25, snout 4; dorsal VI-I, 28; anal III, 28.

#### Family APOGONICHTHYIDÆ.

CARDINAL-FISHES.

##### 45. *APOGONICHTHYS CARINATUS* (Cuvier and Valenciennes).

OKIFUNA (OFF SHORE CARP).

Susaki, May 8, one specimen, 85 mm. long; Urado, May 10, one specimen, 122 mm. long; Kagoshima, June 12, one specimen, 90 mm. long.

46. *AMIA NIGER* (Döderlein).

KUROGENNAI (Susaki).

Susaki, May 8, one specimen, 90 mm. long; Kagoshima, June 12, five specimens, 52 to 88 mm. long. Susaki specimen: Body reddish golden-brown, fins black, except caudal and pectorals.

47. *AMIA MARGINATUS* (Döderlein).

Kagoshima, June 12, two specimens, 67 and 70 mm. long; Yamagawa, June 16, one specimen, 75 mm. long.

48. *AMIA SEMILINEATUS* (Temminck and Schlegel).

MOTSU.

Kochi, May 7, one specimen, 105 mm. long.

49. *AMIA NOTATUS* (Houttuyn).

Kagoshima, June 12, one specimen, 100 mm. long.

50. *AMIA KIENSIS* (Jordan and Snyder).

Urado, May 10, two specimens, 65 and 70 mm. long. Color in life, silvery white with golden reflections below; head and upper parts with purplish reflections; lateral stripes black; dorsal and anal with yellow-brown markings.

## Family SERRANIDÆ.

GROUPERS, SEA BASSES, Etc.

51. *NIPHON SPINOSUS* Cuvier and Valenciennes.

Kochi, May 11, two specimens, 150 mm. long.

52. *CHELIDOPERCA HIRUNDINACEA* (Cuvier and Valenciennes).

Kochi, May 7, one specimen, 112 mm. long; Urado, May 10, one specimen, 143 mm. long.

53. *EPINEPHELUS AREOLATUS* (Forskål).

KORO (Susaki).

Susaki, May 8, one specimen, 54 mm. long; near Yamagawa, June 16, one specimen, 89 mm. long.

54. *EPINEPHELUS EPISTICTUS* (Temminck and Schlegel).

KUYE.

Kochi, May 7, a fine specimen, 300 mm. long.

55. *EPINEPHELUS TSIRIMENARA* (Temminck and Schlegel).

Kochi, May 11, one specimen, 225 mm. long.



56. *SAYONARA MITSUKURII* Smith and Pope, new species.

Head 2.6 in length; depth 2.8; eye 3.5 in head; snout 5.75; interorbital 7; maxillary 2; dorsal x,14; anal III,7; ventrals I,5.

Body ovate, compressed, dorsal, and ventral outlines evenly and similarly curved; head nearly equaling depth, compressed; caudal peduncle compressed, its least depth 3 in head; snout shorter than eye, convex; eye moderate, high, nearly impinging on dorsal profile; interorbital narrow, convex; mouth large, oblique; maxillary reaching below posterior edge of orbit, its distal extremity equaling length of snout; lower jaw slightly projecting; fine villiform teeth on jaws, vomer, and palatines; symphyseal notch of upper jaw without teeth; no prominent canines; tongue smooth, small; preopercle with double margin, the posterior serrated, rounded; opercle with 3 small, short spines nearly concealed by the large scales; gill-membranes free from isthmus; gill-rakers long, slender; dorsals narrowly united at base; dorsal spines

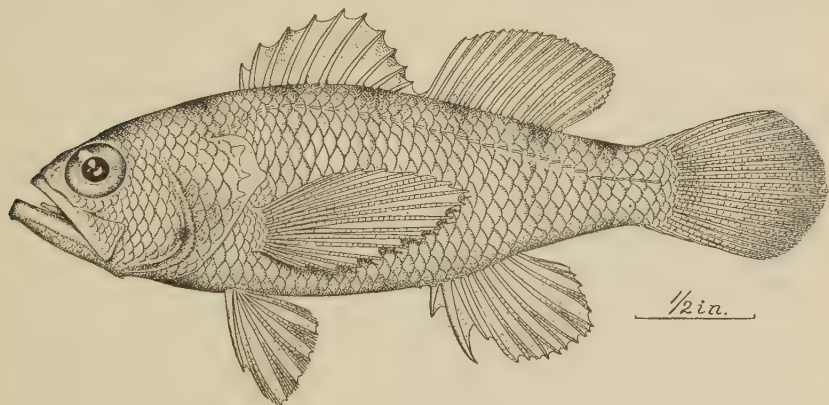


FIG. 3.—*SAYONARA MITSUKURII*. (From the type.)

heteracanthous, the sixth longest and contained 2.5 in head, fifth about same length as sixth, the first one-half diameter of eye; longest rays of soft dorsal contained 2 in head; second anal spine longest and strongest, 2.5 in head; soft dorsal and anal similar; caudal rounded; pectorals 1.12 in head, pointed, the middle rays longest; ventrals short, not reaching insertion of anal; head and body fully scaled; scales large, finely ctenoid, 35 in lateral line; 2 rows of scales between lateral line and origin of dorsal; about 7 rows of scales on cheek; lateral line uninterrupted, high, the tubes extending the entire length of the scales and forming an obtuse angle under middle of last rays of depressed dorsal. Color of alcoholic specimen pale yellow; 7 large irregular blotches of black on upper part of head and body at base of dorsal, suggestive of transverse bars, the first posterior to orbit, the second midway between eye and origin of dorsal, the third at base of fourth, fifth, and sixth dorsal spines, the fourth at base of last dorsal spines,

the fifth at base of anterior rays of soft dorsal, the sixth at base of posterior rays, the seventh on top of caudal peduncle; all fins plain; a blackish tinge on opercle.

Described from a single alcoholic specimen 80 mm. long collected at Kagoshima, June 16, 1903, by H. M. Smith.

*Type*.—Cat. No. 55617, U.S.N.M.

From *Sayonara satsumæ* Jordan and Seale<sup>a</sup> from Kagoshima this species may be distinguished by the larger eye, longer tubules in lateral line, long and slender gill-rakers, higher dorsal fins, unbranched pectoral rays, and color.

Named for Prof. K. Mitsukuri, of the Imperial University at Tokyo.

TOSANA Smith and Pope, new genus (Serranidæ).

Body elongated, moderately compressed, with short, blunt head; dorsal single, without notch, the third spine much the longest, no rays filamentous; caudal crescentic, the lobes produced, upper lobe the longer; anal with the third spine the longest; pectoral rays undivided; scales large and strongly toothed, covering all parts of body and head; lateral line high, its tubes simple; preopercle with vertical limb evenly serrated, its lower margin entire; opercle with 3 flat spines; jaws with enlarged prominent projecting canines; outer row of teeth in upper jaw canines, inner ones fine and villiform; teeth in lower jaw canines in a single row; vomer and palatines with villiform teeth; tongue smooth; no supplemental maxillary; gill-rakers very long and slender; gill-membranes free from the narrow, carinated isthmus.

Similar to *Pseudanthias* Bleeker, but differing therefrom in the unbranched pectoral rays; larger scales, and other characters. From *Pronotogrammus* Gill it may be distinguished by the insertion of the ventrals behind axil of pectorals, the closely scaled top of head, the absence of preopercular spines, the dentition, etc.

The genus is named for Tosa, one of the four provinces of Shikoku. The ancient name for this province meant "the brave good youth," and the "province continues to justify its name for bravery and ability; no men have aided more than the Tosa men to bring about the renovation of Japan."

*Type of genus*.—*Tosana niwæ*.

57. TOSANA NIWÆ Smith and Pope, new species.

Head 3.65 in length; depth 3.62; eye 3 in head; snout 5; interorbital 3.5; dorsal x, 15; anal III, 7; scales in lateral line 35.

Body elongate, compressed, its greatest depth about equal to length of head; dorsal outline but gently arched, the ventral nearly straight; peduncle compressed, its least depth 2 in head; snout short and blunt,

<sup>a</sup>Proc. U. S. Nat. Mus., XXX, 1906, p. 145.

its length equal to 0.66 diameter of eye; mouth oblique; maxillary reaching to below middle of pupil, the width of its distal end more than 0.5 diameter of eye; mandible projecting; teeth in upper jaw in 2 series, the outer canine, the inner in a villiform band; on each side of the tip of the upper jaw one pair of long canines directed downward and another pair directed inward and backward; teeth in lower jaw a single row of canines, with 2 pairs of enlarged canines on each side at tip; a narrow band of small teeth on palatines, and a small patch on vomer; tongue smooth, pointed; preopercle with rounded angle, the upper limb serrated, the lower smooth; opercle with 3 flap spines, the middle longest; gill-rakers long and slender, 23 on lower limb of first arch; scales large, strongly toothed, fully covering body and head, about 6 rows on cheeks; lateral line high, concurrent with back, the tubules straight, simple, and forming an obtuse angle under posterior end of dorsal fin; dorsal fin continuous, the third spine much the longest, 0.5 in head and nearly twice length

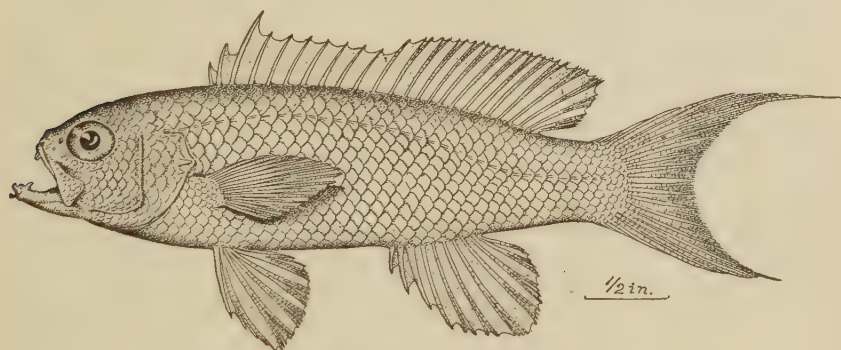


FIG. 4.—*TOSANA NIWÆ*. (From the type.)

of second, fourth to tenth subequal; soft rays of nearly equal length except last 2, the longest considerably longer than third spine; anal shorter and deeper than soft dorsal; caudal deeply and evenly concave, the outer rays much produced, upper lobe longer; pectorals and ventrals shorter than head. Color in alcohol rosy pink, lighter below; all fins yellowish.

This species resembles *Pseudanthias japonicus* (from Japan) and *Pseudanthias cichlops* (from Sumatra); from the former it is distinguished by its slender form, its more numerous gill-rakers (14 on lower arm of first arch in *japonicus*), in having the third dorsal and the third anal spines the longest, and in its deeply concave caudal; from *cichlops* it differs in its more slender body, larger scales, relative length of anterior dorsal and anal spines, shorter ventrals, and shape of caudal.

A single specimen, 110 mm. long, from Ūrado Bay, collected May 10, 1903, by H. M. Smith.



*Type*.—Cat. No. 55618, U.S.N.M.

Named for Mr. H. Niwa, director of the Fishery Experiment Station of Kochi prefecture at Susaki, Tosa.

SATSUMA Smith and Pope, new genus (Serranidæ).

Form elongate, compressed; head pointed; mouth large, with small teeth on jaws, vomer and palatines; maxillary broad posteriorly, lower jaw projecting, its symphysis sharp and dentigerous; eye very large; opercle with 2 spines, preopercle serrated; gill-opening large and continued far forward, gill-membranes not connected and free from isthmus; body covered with finely ctenoid scales; opercles, cheeks, and upper part of head scaly; snout and jaws naked; lateral line high and concurrent with back; 2 high dorsal fins, anterior with 9 strong spines; anal fin deep, with 3 spines; caudal deeply emarginate; pectorals long and pointed; ventrals with 1 long spine.

In the large eye, high dorsal spines, squamation, general form, and color this genus superficially resembles the holocentrids.

*Type of genus*.—*Satsuma macrops*.

58. SATSUMA MACROPS Smith and Pope, new species.

Head, 2.75 in length; depth, 2.6; eye, 2.5 in head; snout, 4; inter-orbital, 4; dorsal, IX-I, 10; anal, III, 7; ventrals, I, 5; scales, 4-40-9; pores, 38.

Body elongate, deep, much compressed, greatest depth at about origin of spinous dorsal; head compressed, a little longer than deep,

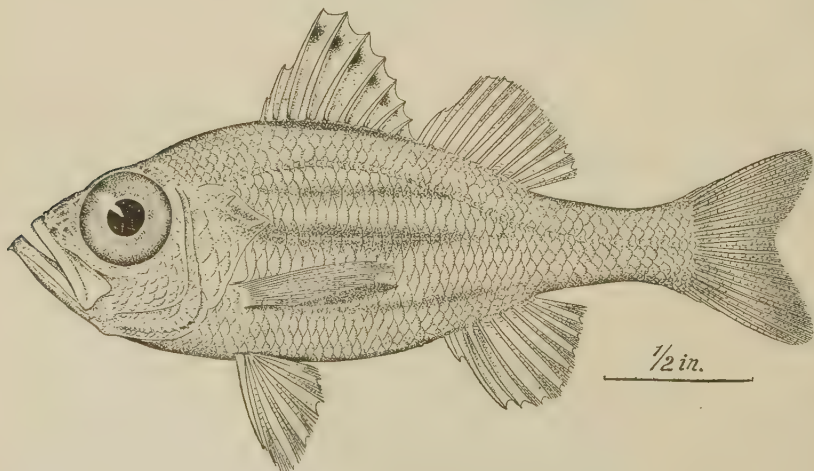


FIG. 5.—SATSUMA MACROPS. (From the type.)

its width 2.2 in its length; snout short, broad, and acute; eye very large, high, impinging upon upper profile of head, its diameter about equal to postocular part of head; mouth large, oblique; mandible



strongly projecting, bearing at the symphysis two sharp conical teeth, and reaching posteriorly to below anterior border of pupil; distal expanded extremity of maxillary 2 in eye; supplemental maxillary bone long and narrow; very fine teeth in jaws, on vomer, and on palatines; tongue elongate, rounded, free.

Nostrils close together, posterior larger and close to front rim of orbit; opercle with two short, sharp spines, the lower horizontal, the upper pointing obliquely upward; preopercle sharply and coarsely serrated; gill-opening large; gill-rakers long and slender, about 23 on lower limb of arch, the longest equaling diameter of pupil and longer than the longest gill-filament; dorsal spines slender, sharp, the third and fourth longest and 1.33 times diameter of eye; the remaining spines descend rapidly to the ninth; soft dorsal lower than spinous; anal similar to soft dorsal and opposite the latter, the depressed tips of last rays of both fins on same vertical; anal spines strong, the first contained in the third three times; third anal spine equal to eye; caudal weakly forked or deeply emarginate; ventrals inserted under origin of pectorals and not reaching vent, 2 in head, and 0.66 length of pectoral; caudal peduncle moderate and compressed, its depth 3 in head; scales of moderate size, finely ctenoid, covering entire body and head except mandible and snout; lateral line high and concurrent with dorsal outline to middle of base of caudal; head with many mucus cavities.

Color, pale yellowish with 5 longitudinal bands or dashes of crimson; the first band very narrow, running along base of dorsal; the second beginning near lateral line below origin of spinous dorsal and terminating on lateral line below middle of soft dorsal; the third and widest band extending from the upper portion of opercle on median line of side to beyond termination of band above; the fourth reaching from axil of pectoral to above base of anal; the fifth from axil of ventrals to posterior end of anal; first and fifth bands similar, second and third running parallel along middle of side and very conspicuous, while the fourth shows but faintly in the specimens secured; in one of the cotypes the third and fourth bands show evidences of a possible fusion at their anterior ends; a black spot near margin of membranes of spinous dorsal, other fins colorless; scales above lateral line with black-dotted margins, those elsewhere on body diffusely dotted with black.

The above description from a specimen measuring 65 mm., and two cotypes 65 and 69 mm. long, taken at Kagoshima, June 16, 1903, by H. M. Smith.

*Type*.—Cat. No. 55616, U.S.N.M.

This interesting form is easily recognized by the two prominently projecting mandibular teeth that terminate the very sharply pointed head, the large eye, the high spinous dorsal, and the brilliant crimson dashes along the sides.

## Family LATILIDÆ.

TILE-FISHES.

## 59. LATILUS JAPONICUS (Houttuyn).

AMADAI (SWEET PERCH).

Kochi, May 7, one specimen, 230 mm. long. Color when fresh: Body reddish, nape bright red; dorsal pale red; anal sky blue; lower third of caudal blue, upper two-thirds blue-and-yellow striped; pectorals pale red; ventrals white.

## Family CEPOLIDÆ.

BAND-FISHES.

## 60. ACANTHOCEPOLA KRUSENSTERNII (Temminck and Schlegel).

Hamashima, October 5, 1902, one specimen, 530 mm. long, from a depth of 6 to 7 fathoms; from Hamashima Fishery Station.

## 61. ACANTHOCEPOLA LIMBATA (Cuvier and Valenciennes.)

KANEHIRA.

Urado, May 10, one specimen, 540 mm. long. Body golden pink; head silvery white below; iris red; dorsal with a black ocellus anteriorly and a white triangular spot at base of each membrane; anal red, edged with black, white at base. Rare at Urado and Kochi.

## 62. CEPOLA SCHLEGELI Bleeker.

Hamashima, October 5, 1902, one specimen, 270 mm. long, from a depth of 6 to 7 fathoms; from Hamashima Fishery Station.

## Family PRIACANTHIDÆ.

## 63. PSEUDOPRIACANTHUS NIPHONIUS (Cuvier and Valenciennes).

Urado, May 10, one specimen, 90 mm. long.

## Family LUTIANIDÆ.

SNAPPERS.

## 64. LUTIANUS NISHIKAWÆ Smith and Pope, new species.

Head 2.6; depth 2.6; eye 3.75; snout 3.25; maxillary 2.33; interorbital 5; dorsal x, 15; anal III, 8; ventrals I, 5; scales in lateral line 52.

Body moderately short and compressed; dorsal outline elevated, the greatest depth at base of third and fourth dorsal spines; profile of head from tip of snout to occiput nearly straight or but very slightly concave; ventral outline nearly horizontal; snout longer than eye, conical; eye moderate, high; jaws about equal; maxillary extending to below anterior margin of pupil; canine teeth in jaws, a pair of larger ones on premaxillaries and similar widely separated ones on mandible;

fine villiform teeth on vomer and palatines; no lingual teeth; preopercular margin finely serrated, with rounded angle and a shallow emargination; opercle terminating in a pointed flap, the spines minute and concealed; gill-rakers long, about 10 to 12 on lower limb of arch; first dorsal spine 0.5 diameter of eye, third spine the longest and equal to distance from tip of snout to middle of pupil; soft dorsal and anal rounded; second anal spine longest and strongest, more than twice the length of the first; pectorals pointed, 1.25 in head, ventrals extending to 0.75 distance to anal spines; scales small, finely ctenoid, in oblique series above lateral line, in horizontal series below; bases of anal and soft dorsal thickly scaled, lateral line continuous, concurrent with dorsal outline; 9 rows of scales between lateral line and insertion of dorsal. Color of alcoholic specimen: Green, with 4 dark longitudinal stripes, the first from upper edge of eye to end of spinous dorsal, the second through the upper part of eye to base of last dorsal rays, the third from center of eye to the upper half of the base of the caudal fin, the fourth from below eye to lower base of caudal peduncle, the second and third stripes beginning at tip of snout and running together to middle anterior margin of eye; a large black blotch on the lateral line from the twenty-second to the twenty-third scale, with the third black horizontal stripe passing through its base; a black spot in the axil of the pectorals.

Described from a single specimen 77 mm. long, collected at Hamashima, April 3, 1902, obtained from Hamashima Fishery Station by H. M. Smith.

*Type*.—Cat. No. 55614 U.S.N.M.

This species is without doubt the fish described and figured by Day,<sup>a</sup> and erroneously identified as *Lutjanus chrysotaenia* of Bleeker, from which it differs noticeably in the smaller number of scales in lateral line (80 in Bleeker's description, but 52 in Day's), in the shallower preopercular notch, and in the coloration. The differences in coloration are especially striking; in Bleeker's fish the color is given as bluish green with 8 or more narrow, sinuous, dark-edged bands somewhat oblique above the lateral line and horizontal below it, and many yellow spots on head; in Day's fish and the one we have here described there are but four dark or blackish bands on a green background.

Named for Dr. T. Nishikawa, formerly of the Imperial Fisheries Bureau.

65. TERAPON OXYRHYNCHUS Temminck and Schlegel.

SUMIHIKI; KOTOHIKI.

Kochi, May 7, one specimen, 171 mm. long; Matsushima Bay, one specimen, 149 mm. long; from Fishery Experiment Station, Shiogama.

<sup>a</sup>The Fishes of India, 1875, p. 36, pl. xi, fig. 3.

66. TERAPON JARBUA (Forskål).  
KOTOHIKI.

Kochi, May 7, one specimen, 75 mm. long. Known from India, Borneo, Philippines, China, Samoa, etc., but not previously recorded from Japan.

Family HÆMULIDÆ.  
GRUNTS.

67. PLECTORHYNCHUS PICTUM (Thunberg.)  
SUMIYAKI.

Hamashima. April 8, 1902, two specimens, 80 and 95 mm. long; from Hamashima Fishery Station.

68. PLECTORHYNCHUS CINCTUS (Temminck and Schlegel).

Kochi, May 7, one specimen, 262 mm. long.

69. PARAPRISTIPOMA TRILINEATUM (Thunberg).

(*Pristipoma japonicum* CUVIER and VALENCIENNES.)

Urado, May 10, one specimen, 270 mm. long.

70. HAPALOGENYS NIGRIPINNIS (Temminck and Schlegel).

Kochi, May 11, one specimen, 130 mm. long.

71. HAPALOGENYS KISHINOUEI Smith and Pope, new species.

Head, 2.6; depth, 2; eye, 3; snout, 3.4; interorbital, 4; dorsal, XII, 14; anal, III, 10; scales in lateral line, 50; gill-rakers, 11+5.

Body short, high, much compressed; dorsal outline greatly arched, ventral outline nearly straight; caudal peduncle compressed, its least depth 3 in head; snout bluntly pointed; mouth moderate, horizontal, the jaws about equal; maxillary reaching to beyond anterior margin of pupil; jaws with villiform teeth, the anterior larger and sharply pointed; roof of mouth toothless, but lined with villiform membranes; symphyseal notch of upper jaw deep; 4 large pores on lower side of mandible; papillæ on mandible minute and close-set; gill-rakers short and thick; preopercle serrate, the denticulations much coarser at the rounded angle; opercle with 2 short spines, the lower the sharper; spinous dorsal preceded by a sharp procumbent spine a little shorter than the first upright spine; all the spines strong, the fourth the longest and equal to distance from tip of snout to posterior rim of orbit, the remaining spines graduated; soft dorsal short and rounded, with finely scaled base; base of spinous dorsal about twice length of soft portion; anal short and rounded, similar to soft dorsal and preceded by 3 strong spines, of which the second, the longest, is 0.5 head; caudal rounded; ventrals with outer rays the longest; scales



finely ctenoid; snout and chin naked; lateral line concurrent with dorsal profile. Color in alcohol silvery gray, with 4 reddish-brown horizontal bands, the first band running along the base of spinous dorsal, the second from midway between eye and origin of dorsal to middle of base of soft dorsal, the third from eye to end of soft dorsal at top of caudal peduncle, the fourth from cheek under eye to end of anal on caudal peduncle; dorsal, anal, and ventrals black; caudal and pectorals slightly dusky.

Described from a specimen 115 mm. long, collected by H. M. Smith, at Urado, May 10, 1903.

*Type*.—Cat. No. 55610, U.S.N.M.

Named for Dr. K. Kishinouye, of the Imperial Fisheries Bureau.

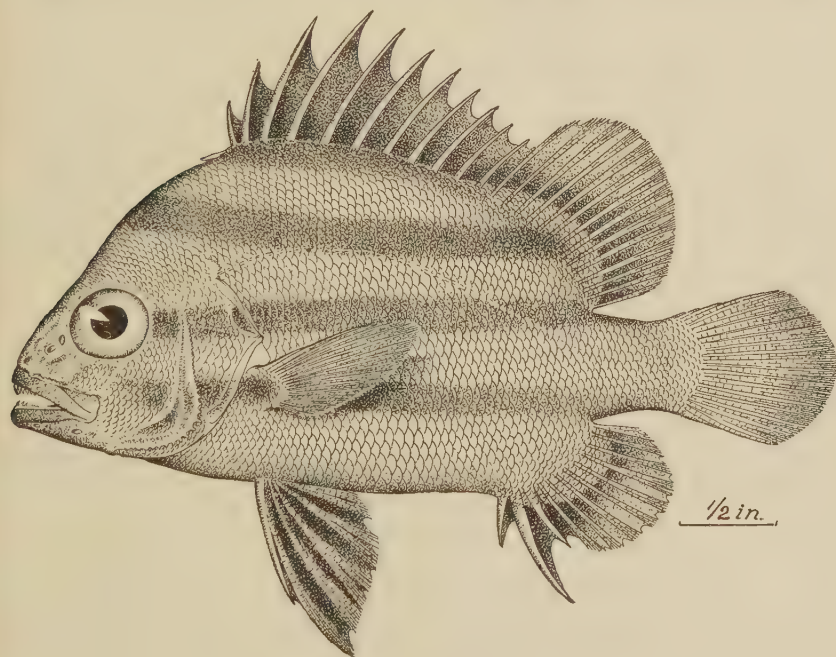


FIG. 6.—*HAPALOGENYS KISHINOUEI*. (From the type.)

### Family SPARIDÆ.

TAI, SCUP, etc.

#### 72. *SCOLOPSIDES INERMIS* (Temminck and Schlegel).

Kagoshima, June 16, two specimens, 98 and 115 mm. long.

#### 73. *LETHRINUS RICHARDSONII* Günther. KUCHIBI.

Susaki, May 8, one specimen, 100 mm. long.

74. *DENTEX HYPSELOSOMUS* Bleeker.  
KODAI.

Kochi, May 7, one specimen, 150 mm. long.

75. *NEMIPTERUS SINENSIS* (Lacépède).  
ITOYORI.

Kochi, May 7, one specimen, 205 mm. long.

Family *KYPHOSIDÆ*.  
RUDDER-FISHES.

76. *GIRELLA PUNCTATA* Gray.

Matsushima Bay, one specimen, 135 mm. long; from Fishery Experiment Station, Shiogama.

Family *GERRIDÆ*.  
MOJARRAS.

77. *XYSTÆMA JAPONICUS* (Bleeker).  
AMAGI.

Kochi, May 7, one specimen, 110 mm. long; Urado, May 10, one specimen, 127 mm. long. A very common fish in the Kochi region, often taken in the cast-net fishery. Caudal pale greenish yellow; ventrals and first 2 anal membranes chrome yellow.

78. *XYSTÆMA OYENA* (Cuvier and Valenciennes).

Yamagawa, June 16, one specimen, 130 mm. long.

Family *SCIÆNIDÆ*.  
DRUMS.

79. *CORVULA ARGENTATA* Houttuyn.  
SHIRABU

[*Corvula schlegeli* (BLEEKER); *Sciæna sinu* TEMMINCK and SCHLEGEL.]

Kochi, May 7, one specimen, 148 mm. long.

80. *PSEUDOTOLITHUS MITSUKURII* Jordan and Snyder.  
GUCHI.

Kochi, May 7, one specimen, 207 mm. long.

Family *SILLAGINIDÆ*.

81. *SILLAGO SIHAMA* (Forskål).

Yamagawa, June 14, one specimen, 115 mm. long.

82. *SILLAGO JAPONICA* (Temminck and Schlegel).  
KISUGO.

Kochi, May 7, one specimen, 145 mm. long.

## Family OPLEGNATHIDÆ.

## 83. OPLEGNATHUS FASCIATUS (Temminck and Schlegel).

KUROME (BLACK EYE); TABAKOUWO (TOBACCO-FISH).

Hamashima, April 10, 1902, one specimen, 67 mm. long, from a depth of 6 to 7 fathoms; from Hamashima Fishery Station. Matsushima Bay, one specimen, 140 mm. long; from Fishery Experiment Station, Shiogama. The local names given are in use at Hamashima.

## 84. OPLEGNATHUS PUNCTATUS (Temminck and Schlegel).

Matsushima Bay, one specimen, 158 mm. long; from Fishery Experiment Station, Shiogama. Hamashima, March 7, 1902, three specimens, 55 to 80 mm. long, from a depth of 6 to 7 fathoms; from Hamashima Fishery Station.

## Family PENTACEROTIDÆ.

## 85. HISTIOPTERUS TYPUS Temminck and Schlegel.

HIDARIMAKI.

Kochi, May 7, one specimen, 195 mm. long; May 11, one specimen, 115 mm. long.

## Family MULLIDÆ.

SURMULLETS.

## 86. UPENEUS JAPONICUS (Houttuyn).

(*Upeneus bensasi* TEMMINCK and SCHLEGEL.)

HIMEJI (Kochi).

Matsushima Bay, one specimen, 76 mm. long; from Fishery Experiment Station, Shiogama. Kochi, May 7, two specimens, 140 and 110 mm. long; Kagoshima, June 16, one specimen, 143 mm. long.

## 87. UPENEUS TRAGULA Richardson.

KUROHIMEJI (Susaki).

Susaki, May 8, one specimen, 145 mm. long; Yamagawa, June 14, one specimen, 110 mm. long; June 16, three specimens, 112 to 162 mm. long.

## Family EMBIOTOCIDÆ.

SURF-FISHES.

## 88. DITREMA TEMMINCKII Bleeker.

Matsushima Bay, one specimen, 118 mm. long; from Fishery Experiment Station, Shiogama.

## Family POMACENTRIDÆ.

DEMOISELLES.

## 89. AMPHIPRION POLYMNUS (Linnæus).

Urado, May 10, one specimen, 110 mm. long.

Family LABRIDÆ.  
LABRIDS, OR LIPPED FISHES.

90. CHÆROPS AZURIO Jordan and Snyder.

ISOMADAI (Kochi); TESU (Hamashima).

Kochi (fish market), May 11, one specimen, 365 mm. long. Hamashima, November 10, 1902, one specimen, 185 mm. long; from Hamashima Fishery Station. At Kagoshima, where this species is called "hachi," a number were seen.

91. DUYMÆRIA FLAGELLIFERA (Cuvier and Valenciennes).  
KUROHACHI.

Kagoshima, June 16, one specimen, 170 mm. long, male, from depth of 20 fathoms; said to be rare at Kagoshima.

92. PSEUDOLABRUS GRACILIS (Steindachner).

Near Yamagawa, June 16, one specimen, 138 mm. long.

93. HALICHÆRES PÆCIOPTERUS (Temminck and Schlegel).  
KUSABE.

Yamagawa, June 14, two specimens, 160 and 195 mm. long, both females.

94. INIISTIUS DEA (Temminck and Schlegel).  
METESU.

Hamashima, November 10, 1902, one specimen, 180 mm. long, from offshore; from Hamashima Fishery Station.

Family ZEIDÆ.  
JOHN DORIES.

95. ZEUS JAPONICUS Cuvier and Valenciennes.  
MATOWO.

Susaki, May 8, one specimen, 100 mm. long.

Family CHÆTODONTIDÆ.  
BUTTERFLY-FISHES.

96. CORADION DESMOTES Jordan and Fowler.

Urado, May 10, one specimen, 130 mm. long. Body white, vertical bars greenish yellow, dorsal ocellus black with a white border.

Family ACANTHURIDÆ.  
SURGEON-FISHES.

97. ACANTHURUS UNICORNIS (Forskål).

Matsushima Bay, one specimen, 80 mm. long; from Fishery Experiment Station, Shiogama. This specimen has 3 rows of small, round dark spots on sides.



## Family SIGANIDÆ.

98. *SIGANUS FUSCESCENS* (Houttuyn).  
ENOBA.

Kagoshima, June 16, two specimens, 136 and 140 mm. long; depth 2 to 3 fathoms; very plentiful. Back light green, below whitish green, entire body covered with pearly spots; fins green.

## Family TRIACANTHIDÆ.

99. *TRIACANTHODES ANOMALUS* (Temminck and Schlegel).

Kochi and Urado, May 10, three specimens, 103 to 120 mm. long.

100. *TRIACANTHUS BREVIROSTRIS* Temminck and Schlegel.  
TOGEHAGE (SPINY FILE-FISH).

Hamashima, October 2, 1902, one specimen, 98 mm. long; from Hamashima Fishery Station.

Family BALISTIDÆ.  
TRIGGER-FISHES.101. *CANTHIDERMIS ROTUNDATUS* (Procé).

Hamashima, April 10, 1902, one specimen, 100 mm. long; from Hamashima Fishery Station. This specimen seems to be referable to this species, although it differs somewhat in its proportions. Depth 1.8; head 2.66; eye 2 in snout, 4 in head; dorsal III-25; anal 22. Body dark greenish brown, with darker narrow longitudinal stripes on every third row of scales; body with small round light spots irregularly disposed; fins bluish black.

Family MONACANTHIDÆ.  
FILE-FISHES.102. *RUDARIUS ERCODES* Jordan and Fowler.  
KOMEUWO.

Yamagawa, June 14, one specimen, 52 mm. long.

103. *OSBECKIA SCRIPTA* (Osbeck).  
MATSUZURAHAGI.

Hamashima, April 3, 1902, one specimen, 215 mm. long; from Hamashima Fishery Station.

Family OSTRACIIDÆ.  
TRUNK-FISHES.104. *ARACANA ACULEATA* (Houttuyn).  
SUSUMEFUGU.

Urado, May 10, one young specimen, 35 mm. long, with spines lacking.

## Family TETRAODONTIDÆ.

## PUFFERS.

105. SPHEROIDES VERMICULARIS (Temminck and Schlegel).

Yamagawa, June 14, one specimen, 275 mm. long.

106. SPHEROIDES NIPHOBLIS Jordan and Snyder.

Kochi, May 11, one specimen, 140 mm. long. - Back dark green, the spots pale yellow in life.

## Family CANTHIGASTERIDÆ.

## SHARP-NOSED PUFFERS.

107. CANTHIGASTER RIVULATUS (Temminck and Schlegel).

## FUGU.

Susaki, May 8, one specimen, 30 mm. long; not known to the fishermen. Yamagawa, June 14, one specimen, 108 mm. long; common; average size 75 mm.

## Family SCORPÆNIDÆ.

## SCORPION FISHES.

108. SEBASTICHTHYS OBLONGUS (Günther).

## GARA.

Hamashima, March 10, 1902, one specimen, 82 mm. long; from Hamashima Fishery Station. Scales in lateral line 50 +.

109. SEBASTICUS ALBOFASCIATUS (Lacépède).

Kochi, May 10, one specimen, 167 mm. long.

110. HELICOLENUS DACTYLOPTERUS (de la Roche).

## HOGO.

Kagoshima, June 16, two specimens, 127 and 135 mm. long; from a depth of about 80 fathoms; plentiful.

111. SCORPÆNA ONARIA Jordan and Snyder.

Urado, May 10, one specimen, 128 mm. long; mottled red and brown; anal with blood-red spots.

112. SCORPÆNOPSIS KAGOSHIMANA (Steindachner and Döderlein).

## OKOZE.

Kagoshima, June 11 and 16, four specimens, 115 to 180 mm. long; abundant at a depth of 2 to 3 fathoms. In all these specimens the pectoral extends far beyond the ventrals, but only in the three smaller specimens (115 to 140 mm.) does the pectoral extend as far as the second anal spine; in the largest specimen the tip of the pectoral is

considerably short of the first anal spine. It appears improbable that the distinction between *S. kagoshimana* and *S. cirrhosa* can be maintained.

113. *PTEROIS LUNULATA* Temminck and Schlegel.

OKOZE.

Kochi and Urado, May 10 and 11, two specimens, 80 and 105 mm. long.

114. *APISTUS EVOLANS* Jordan and Starks.

Kagoshima, June 13, two specimens, 100 and 125 mm. long.

115. *DECTERIAS PUSILLUS* (Temminck and Schlegel).

Susaki, May 8, one specimen, 52 mm. long; Kagoshima, June 13, one specimen, 56 mm. long.

116. *EROSA EROSA* (Langsdorff).

YUWAOKOZE.

Kagoshima, June 16, one specimen, 125 mm. long; from a depth of 2 to 3 fathoms; plentiful.

117. *INIMICUS JAPONICUS* (Cuvier and Valenciennes).

Yamagawa, June 14, two specimens, 165 and 180 mm. long.

118. *PARACENTROPOGON RUBRIPINNIS* (Temminck and Schlegel).

Near Yamagawa, June 16, three specimens, 51 to 62 mm. long; shore.

*LYSODERMUS* Smith and Pope, new genus (Scorpænidæ).

Body oblong, compressed, covered with a soft, lax skin, in which minute rudimentary scales are embedded; head very rough with spines and ridges; 2 preorbital spines, 5 preopercular spines (the upper longest), 2 concealed opercular spines; a short slit behind last gill-arch; gill-rakers short and few; gill-membranes united to isthmus; lips papillose; lower jaw with fleshy tentacles; dorsal fin single, beginning behind head and consisting of 7 stiff spines and numerous soft rays; anal fin with 2 concealed spines; caudal margin slightly convex; all but tips of dorsal, anal, and caudal fins invested with skin; pectorals with lower ray free and long; ventrals joined to abdomen by a thick fold of skin.

This genus differs from *Minous*, which it rather closely resembles, in having but 7 dorsal spines, in the origin of the fin well behind head and axil of pectorals, in the presence of minute embedded scales, in the rudimentary anal spines, and in various other characters.

*Type of genus.*—*Lysodermus satsumæ*.

119. *LYSODERMUS SATSUMÆ* Smith and Pope, new species.

Head, 3.5 in length without caudal; depth, 3.5; eye, 4.75 in head; maxillary, 2.25; dorsal, VII, 12; anal, II, 9.

Form elongate, compressed, especially in dorsal region, so that body in cross section is triangular; dorsal and ventral outlines similar, caudal peduncle short, its least depth equal to snout; head pointed; mouth moderate, maxillary extending as far as anterior margin of eye, lower jaw strongly projecting; minute villiform teeth in bands in jaws and in two separated patches on vomer, none on palatines; a row of six or more tentacles on cornea above pupil; numerous blunt, fleshy papillae on maxillary, mandible, cheeks, opercles, throat, and isthmus; a patch of papilliform tentacles on under side of tip of mandible, a single papilla about diameter of pupil posterior to the patch on each side, and more posteriorly another single papilla about half diameter of eye on each side; bones of head rough and deeply sculptured; interorbital

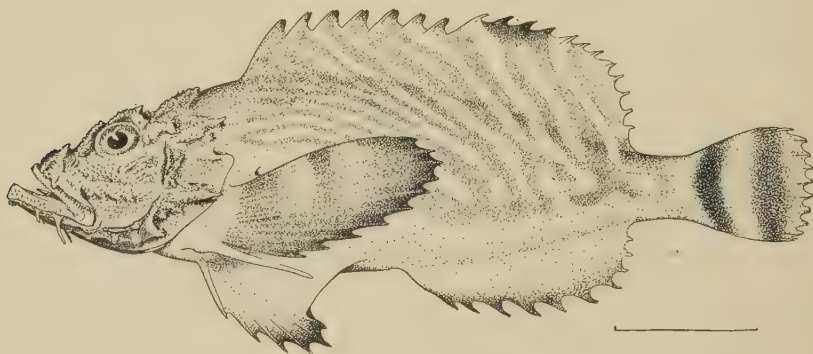


FIG. 7.—*LYSODERMUS SATSUMÆ*. (From the type.)

space deeply concave, as wide as orbit, with 2 longitudinal ridges, between which is a slight median ridge which divides and diverges posteriorly; a long, sharp preorbital spine reaching to end of maxillary and a smaller spine in front pointing downward; suborbitals wide and deeply striated; nasals ending above in produced angles, but not in spines; a transverse depression on top of head behind eye; parietals produced in wide, blunt ridges which end behind in blunt spines; a postorbital ridge extending on posttemporal and ending in a spine; opercle with 2 concealed spines; preopercle with a large, horizontal spine reaching to branchial opening and 4 shorter spines below; gill-rakers small and blunt, 9 on lower limb of first arch; skin smooth to the touch, containing rudimentary embedded scales and very loosely attached to underlying tissue and investing all the fins more or less completely except their tips; lateral line continuous but inconspicuous, only 3 small pores developed anteriorly; a single dorsal fin without notch separating the two parts, beginning posterior to head;



the spines rather low and of nearly uniform height, the longest equal to distance from pupil to end of snout; soft dorsal rays longer than spines except posteriorly, where the fin is evenly rounded; anal similar to soft dorsal, but lower, the spines wholly covered by skin; caudal slightly rounded, the margin serrate; pectorals large, extending beyond origin of anal, the rays simple; the detached ray tapering, its length more than 0.5 head; ventrals extending beyond vent, broadly adnate to abdomen.

Color white, back and sides with dark brown vermiculated oblique bands which extend on dorsal fin; between occiput and dorsal origin the bands are blended and the color is more or less uniform; a black spot on membrane behind tip of each dorsal spine; a larger black spot across tips of the second, third, and fourth dorsal rays; anal and ventrals black on distal part; pectorals black, with a light median part crossed by a black bar; free ray of pectoral yellowish; caudal crossed by 2 black bands.

Described from one specimen 140 mm. in length obtained at Kago-shima, June 16, 1903, by H. M. Smith.

*Type*.—Cat. No. 55615, U.S.N.M.

#### Family ANOPILOMATIDÆ.

##### 120. *ERILEPIS ZONIFER* (Lockington).

(*Ebisus sagamius* JORDAN and SNYDER.)

Matsushima B.y, one specimen 87 mm. long; from Fishery Experiment Station, Shiogama. This specimen agrees perfectly with the description of the type from Monterey Bay, California. According to Jordan and Snyder this species occasionally reaches a weight of 200 pounds in Japan, and is not rare. The single known American specimen was evidently a stray, as Doctor Jordan advises us that he saw Lockington's specimen when fresh and that it could not have come from Japan.

#### Family COTTIDÆ.

##### SCULPINS.

##### 121. *COTTUS KAZIKA* Jordan and Starks. KAMAKIRI.

Kochi, May 7, one specimen, 46 mm. long.

##### 122. *COTTUS POLLUX* Günther.

Nigara River, near Gifu, May 20, three specimens, 85 to 130 mm. long; caught by cormorants.

##### 123. *MYOXOCEPHALUS RANINUS* Jordan and Starks.

Matsushima Bay, one specimen, 175 mm. long; from Fishery Experiment Station, Shiogama.

124. *PSEUDOBLENNIUS COTTOIDES* (Richardson).

Hamashima, October 2, 1902, one specimen, 79 mm. long; from Hamashima Fishery Station.

125. *PSEUDOBLENNIUS MARMORATUS* (Döderlein).

Matsushima Bay, two specimens, 112 and 115 mm. long; from Fishery Experiment Station, Shiogama.

Family *PLATYCEPHALIDÆ*.

## FLAT-HEADS.

126. *PLATYCEPHALUS INDICUS* (Linnæus).

## MATSUJI.

Kagoshima, June 11, one specimen, 223 mm. long.

127. *PLATYCEPHALUS JAPONICUS* Tilesius.

## KOCHI.

Kochi, May 7, one specimen, 190 mm. long; Kagoshima, June 11, one specimen, 183 mm. long.

128. *PLATYCEPHALUS PUNCTATUS* Cuvier and Valenciennes.

Yamagawa, June 16, one specimen, 238 mm. long.

129. *INSIDIATOR RUDIS* (Günther).

## KOCHI.

Kochi, May 7, one specimen, 190 mm. long.

130. *INSIDIATOR HOSOKAWÆ* Smith and Pope, new species.

Head about 3 in length, its width 1.75 in its length; depth, 7; snout, 3.75 in head; eye slightly less than snout; interorbital, 3 in eye; scales in lateral line, 42; dorsal I, VIII-12; anal 12.

Maxillary extending to vertical through anterior margin of pupil; lower jaw projecting; fine villiform teeth on jaws, vomer, and palatines; opercle with 2 sharp spines, its flap with a strongly upturned and rounded corner; 4 spines at angle of preopercle, of which the most posterior is longest and bears a superimposed spine at its base; 4 radiating spines on preorbital; a spine on anterior rim of orbit; sub-orbital with a conspicuous notch below the pupil, the notch preceded by 4 sharp recurved spines and followed by a strongly serrated ridge of 11 or 12 recurved spines; snout and supraorbital, postorbital, and occipital ridges spiniferous; scales rather large, thin, ciliated; tubes of lateral line broad; 3 spines at anterior end of lateral line; nostrils with a dermal tentacle; a short tentacle on cornea posterior to pupil; origin of spinous dorsal over base of ventrals, longest spine (third) 0.5 head; longest rays of soft dorsal about length of second dorsal spine, base of soft dorsal shorter than that of anal; longest anal rays less

than 0.33 head; caudal fan-shaped; least depth of caudal peduncle 0.66 diameter of eye. Color in alcohol yellowish brown above, with faint indications of several dark bars, the edges of scales dark; lighter below; all fins except anal with rows of dusky spots on rays or membranes, or on both.

Described from a specimen 115 mm. long collected at Urado, May 10, 1903, by H. M. Smith.

*Type.*—Cat. No. 55611, U.S.N.M. A second specimen from same locality is exactly similar.



FIG. 8.—INSIDIATOR HOSOKAWÆ. (From the type.)

This species is readily distinguished from *I. spinosus* and *macrolepis*, the most closely related species, by the deep notch on the strongly serrated suborbital ridge, and by the more depressed and elongate head.

Named for Mr. Y. Hosokawa, president of the Fishermen's Association of Kōchi prefecture.

#### 131. INSIDIATOR MACROLEPIS (Bleeker).

Kagoshima and Yamagawa, June 12, 13, and 16, five specimens, 67 to 118 mm. long. Ventrals extend beyond origin of anal and show 3 distinct zones of color—white at base and tip, a broad black band between; pectorals with upper rays black-spotted, lower nearly uniform black.

#### Family OPLICHTHYIDÆ.

#### 132. OPLICHTHYS LANGSDORFI Cuvier and Valenciennes.

YASURI (Urado).

Urado, May 10, one specimen, 140 mm. long; Kagoshima, June 13, one specimen, 98 mm. long.

## Family BEMBRADIDÆ.

133. BEMBRAS JAPONICUS Cuvier and Valenciennes.  
OKIGOCHI.

Susaki, May 8, one specimen, 113 mm. long; Urado, May 10, one specimen, 117 mm. long; Kochi, May 11, two specimens, 92 and 220 mm. long.

## Family LIPARIDIDÆ.

SEA-SNAILS.

134. LIPARIS AGASSIZII Putnam.

Matsushima Bay, three specimens, 40 to 225 mm. long; from Fishery Experiment Station, Shiogama.

## Family TRIGLIDÆ.

GURNARDS.

135. LEPIDOTRIGLA ALATA (Houttuyn.)

Near Yamagawa, June 16, numerous specimens from 70 to 90 mm. long. Two specimens exhibit variation in the length and shape of the preorbital processes.

136. LEPIDOTRIGLA GUNTHERI Hilgendorf.

Urado, May 11, three specimens, 130 to 140 mm. long; from a depth of 350 feet.

137. LEPIDOTRIGLA MICROPTERA Günther.

Kochi, May 7, one specimen, 138 mm. long; Susaki, May 8, one specimen, 34 mm. long.

## Family PERISTEDIIDÆ.

DEEP-WATER GURNARDS.

138. PERISTEDION RIEFFELI Kaup.

Urado, May 10, one specimen, 230 mm. long; Uchinoura Bay, east of Kagoshima Bay, one specimen, 325 mm. long. In May, 1901, there were taken on a long line in Uchinoura Bay at a depth of 120 fathoms two specimens of this fish, which were the only ones ever seen in that region; these dried specimens were found in the Commercial Museum at Kagoshima: one of them is mentioned above, the other, of the same size, is still in the museum. This species has not heretofore been recorded from Japan. It is easily distinguishable from *P. orientale* by the converging preorbital processes, the single spine on upper surface of snout, the presence of spines above eye and on occiput, the spottiness of the upper parts and of the dorsals, and the presence of two additional series of plates at base of caudal fin.



Family GOBIIDÆ.  
GOBIES.

139. *ELEOTRIODES HELSDINGENII* Bleeker.

Uradu, May 7, one specimen, 120 mm. long without the caudal filaments. This species, which was described by Bleeker in 1858 from a single specimen, 120 mm. long without caudal filaments, from the Sea of Goram, does not appear to have been met with since. The Japa-

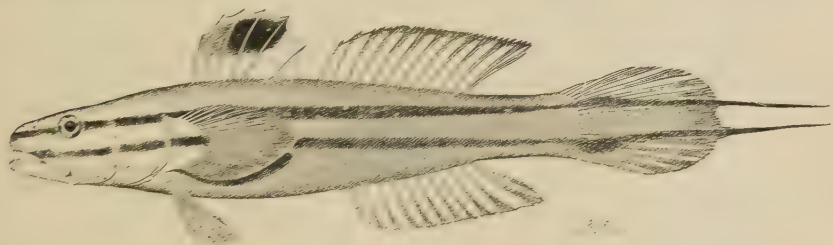


FIG. 9.—*ELEOTRIODES HELSDINGENII*.

nese specimen, of which a figure is here given, agrees perfectly with Bleeker's original description,\* an abridgment of which is as follows:

Dorsal vi-r, 11 or 12; anal i, 11. Body elongated, compressed, depth one-seventh of the total length (with caudal filament); body covered with minute ctenoid scales, about 100 in lateral series; head naked, depressed anteriorly, the interorbital space less, the length of the snout more, than the diameter of the eye; the maxillary extends to below middle of orbit; the two caudal rays which are nearest to the three middle ones are prolonged into long filaments, color above greenish rose with two brown bands from tip of snout to the caudal filaments; spinous dorsal with a broad dark slender spot on its upper portion surrounded by white border; soft dorsal with a brownish margin; ventrals, anal, and pectorals plain or yellowish; caudal with its filaments of same color as body stripes.

140. *CTENOGOBIOUS SIMILIS* (Gill).

Setagawa, Lake Biwa, April 22, eight specimens, 45 to 58 mm. long.

141. *CTENOGOBIOUS HADROPTERUS* Jordan and Snyder.  
SHIMAHAZE.

Kochi, May 7, one specimen, 60 mm. long.

142. *CTENOGOBIOUS PFLAUMI* (Bleeker).  
YESO.

Yamagawa and Kagoshima, June 14 and 16, numerous specimens from 57 to 80 mm. long. The row of black spots along sides is quite distinct; throat and branchiostegal membrane with a dark streak; ventrals dusky; eye 0.25 head or less.

\* *Natuurk. Tijds. Nederl. Indie*, XV, 1858, p. 168.

143. *GLOSSOGOBIOUS BRUNNEUS* (Temminck and Schlegel).  
GOMO.

Sendaigawa at Sendai, June 10, one specimen, 165 mm. long.

144. *CHÆNOGOBIUS MACROGNATHOS* (Bleeker).

Kochi, May 11, one specimen, 93 mm. long.

145. *CHASMIAS MISAKIUS* Jordan and Snyder.

Kochi, May 11, one specimen, 75 mm. long.

146. *ACANTHOGOBIOUS FLAVIMANUS* (Temminck and Schlegel).

Matsushima Bay, one specimen, 98 mm. long; from Fishery Experiment Station, Shiogama.

147. *SAGAMIA RUSSULA* Jordan and Snyder.

Kagoshima and Yamagawa, June 13-16, numerous specimens, 51 to 70 mm. long.

148. *CHÆTURICHTHYS HEXANEMUS* (Bleeker).

Matsushima Bay, one specimen, 125 mm. long; from Fishery Experiment Station, Shiogama.

149. *CHÆTURICHTHYS SCIISTIUS* Jordan and Snyder.  
SASAGAREI: GOMO.

Kagoshima, June 12 and 16, four specimens, 68 to 75 mm. long. The specimens were obtained in the market, and the market master stated that two of them came from a depth of 80 fathoms.

150. *TRIDENTIGER OBSCURUS* (Temminck and Schlegel)  
CHICHIBU.

Kochi, May 7, one specimen, 59 mm. long.

151. *TRIDENTIGER BIFASCIATUS* Steindachner.

Matsushima Bay, one specimen, 78 mm. long; from Fishery Experiment Station, Shiogama.

152. *PERIOPHTHALMUS CANTONENSIS* (Osbeck).  
TOBIHAZE (JUMPING GOBY).

Onomichi (Inland Sea), June 2, two specimens, 45 and 80 mm. long; mouth of Iwata River, Bay of Ise, Ise, two specimens, 67 and 74 mm. long, from Hamashima Fishery Station. This species was found to be very abundant in brackish tidal ditches near Onomichi. It is very difficult to catch even with dip nets. It skims over the surface touching only its tail, swims with just its head out, swims under water, jumps out on the bank, perches on stones, buries itself in the mud, hides in crab holes, and behaves in other peculiar ways.

Specimens taken June 2: Head and back olive green; sides bluish with small golden spots and black specks; the body color projected downward in twenty or more teeth-like processes with pale yellow between; abdomen bluish white; ventrals pale yellow; ten or twelve irregular blackish spots on back and sides; checks minutely specked with green, blue, and golden; first dorsal with pale-yellow margin; second dorsal dirty yellow, with blackish markings. The smaller examples have a light-colored body with irregular dark-brown blotches; the larger ones become darker and more uniform, but still show dark bars.

Family CARISTIIDÆ.<sup>a</sup>

153. CARISTIUS JAPONICUS Gill and Smith.

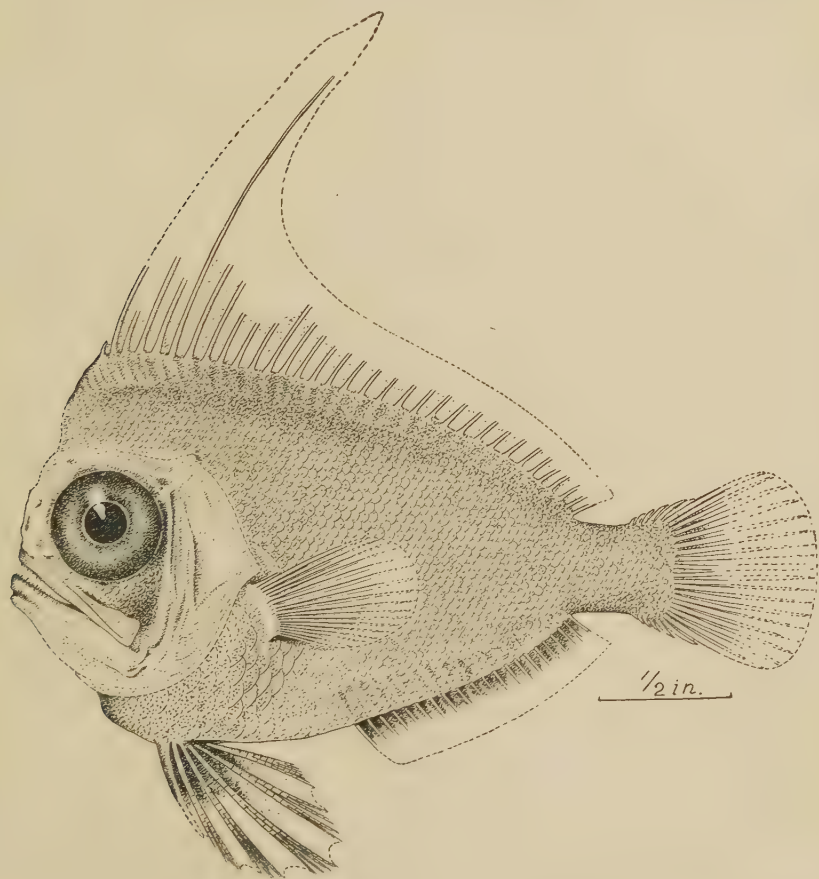


FIG. 10.—CARISTIUS JAPONICUS. (From the type.)

Kagoshima, June 12, one specimen, 75 mm. long. Body much compressed, cuneiform, covered with small, deciduous cycloid scales which

<sup>a</sup> A new family of jugular acanthopterygians. By Theodore Gill and Hugh M. Smith. Proc. Biol. Soc. Wash., XVIII, December 9, 1905, pp. 249-250. *Caristius japonicus* described as a new genus and species.

are enlarged in the pectoral region; depth at ventrals about 1.66 length; head about 0.33 length; mouth large, oblique, the cleft extending under posterior third of eye; teeth in jaws slender, acute, and in several rows; eye very large, its diameter nearly 0.5 head; branchial opening large; no lateral line; dorsal fin single, elongate, the rays about 34, anterior rays high and crowded forward over eyes; anal rays 21; pectorals 19; ventrals nearly as long as head, inserted anterior to pectorals, the rays 1, 5; a median groove or sheath between ventrals and anal; vertebræ about 40, the vertebral column (as shown by skiagraph) singularly deflected downward near and to the occipital condyle.

A single specimen, in poor condition, was obtained in the market at Kagoshima among a miscellaneous lot of small fishes from Kagoshima Bay.

#### Family LEPTOSCOPIDÆ.

##### 154. BEMBROPS CAUDIMACULA Steindachner.

Kagoshima, June 13, three specimens, 110 to 130 mm. long. This species has heretofore been known only from the type specimen, 5.33 inches long, from Nagasaki. The three specimens before us agree perfectly with Steindachner's original description.

#### Family PTEROPSARIDÆ.

##### 155. PARAPERCIS PULCHELLA (Temminck and Schlegel). GOMO.

Kagoshima, June 13, three specimens, 95 to 150 mm. long.

##### 156. PARAPERCIS OMMATURA Jordan and Snyder.

Hamashima, April 4, 1902, one specimen, 105 mm. long; from a depth of 7 to 10 fathoms; from Hamashima Fishery Station.

##### 157. NEOPERCIS SEXFASCIATA (Temminck and Schlegel).

Kagoshima, June 13, one specimen, 125 mm. long; Kochi, May 7, one specimen, 145 mm. long.

##### 158. NEOPERCIS MULTIFASCIATA (Döderlein). DOROHAZE (MUD GOBY).

Hamashima, October 5, 1902, one specimen, 135 mm. long; from a depth of 5 to 10 fathoms; from Hamashima Fishery Station.



159. *NEOPERCIS AURANTICA* (Döderlein).  
OKAHAZE.

Urado, May 10, one specimen, 135 mm. long, in poor condition. Depth, 5.5; head, 4.33; eye, 3; dorsal, iv-23; anal, 21. Color when fresh: Body bright yellow, with brownish-yellow vertical bars and 5 horizontal lines of blue spots between bars; dorsal pale, with a series of yellow blotches along base; anal membranes and tips of rays yellow; caudal with 4 purplish crossbars.

Family *CALLIONYMIDÆ*.  
DRAGONETS.

160. *CALLIURICHTHYS JAPONICUS* (Houttuyn).

Urado, May 10, one specimen, 200 mm. long; Yamagawa, two specimens, 270 and 370 mm. long. Abundant off Kochi; many caught by fishermen of Kochi and Urado at a depth of 350 feet; extensively eaten.

161. *CALLIURICHTHYS DORYSSUS* Jordan and Fowler.

Kochi, May 7, one specimen, 110 mm. long.

162. *CALLIONYMUS LUNATUS* Temminck and Schlegel.

Yamagawa, June 14, one specimen, 87 mm. long.

163. *CALLIONYMUS VALENCIENNESI* Temminck and Schlegel.  
MOTOKUSARI (Kochi).

Kochi, May 7, one specimen, 190 mm. long; Yamagawa, June 14, one specimen, 130 mm. long; Kagoshima, June 13, two specimens, 97 and 120 mm. long.

Family *URANOSCOPIDÆ*.  
STAR-GAZERS.

164. *URANOSCOPUS JAPONICUS* Houttuyn.  
MISHIMABU.

Susaki, May 8, one specimen, 108 mm. long; Urado, May 10, one specimen, 143 mm. long.

165. *URANOSCOPUS BICINCTUS* Temminck and Schlegel.

Kagoshima, June 12, one specimen, 220 mm. long.

Family *BLENNIIDÆ*.  
BLENNIES.

166. *AZUMA EMMNION* Jordan and Snyder.

Matsushima Bay, one specimen, 290 mm. long; from Fishery Experiment Station, Shiogama.

167. *ERNOGRAMMUS HEXAGRAMMUS* (Temminck and Schlegel).

Matsushima Bay, one specimen, 123 mm. long; from Fishery Experiment Station, Shiogama.

168. *DICTYOSOMA BÜRGERI* Van der Hoeven.  
KAMISORI (RAZOR-FISH).

Hamashima, May 18, 1902, three specimens, 110 to 187 mm. long, from a depth of 2 to 3 fathoms; from Hamashima Fishery Station.

## Family AMMODYTIDÆ.

169. *EMBOLICHTHYS MITSUKURII* (Jordan and Evermann).  
OKIAYU.

Kochi, May 7, one specimen, 175 mm. long. Body brownish mottled; opercular region purplish. The tip of the lower jaw projects more strongly than in Jordan and Evermann's figure. Not previously reported from Japan. Rare at Kochi.

Family GADIDÆ.  
CODS.170. *LOTELLA PHYCIS* (Temminck and Schlegel).

Matsushima Bay, one specimen, 220 mm. long; from Fishery Experiment Station, Shiogama.

171. *PHYSICULUS JAPONICUS* Hilgendorf.

Kagoshima, June 13 and 16, two specimens, 180 and 197 mm. long.

Family MACROURIDÆ.  
GRENADIERS.172. *CÆLORHYNCHUS JORDANI* Smith and Pope, new species.

Head 4.5; depth 6.5 in length of body, 1.4 in length of head; snout 2.8 in head; eye equals snout; interorbital 4.5; scales in lateral line about 100; series of scales between dorsal spine and origin of anal 20; dorsal 11, 9-90; anal 90; ventrals 7; pectorals 17.

Snout short, obtuse, moderately depressed, transversely convex, its greatest width opposite front of orbit about equal to longitudinal diameter of eye, its extremity not sharply pointed; antero-lateral portions of snout with naked translucent areas; vertical diameter of orbit contained 1.4 times in longitudinal diameter; posterior nostril vertically elongate but not crescentic, anterior about 0.5 its length; ridges of head distinct; snout with a median dorsal ridge extending from its extremity to a vertical drawn through anterior margin of eye; a low curved ridge anterior to nostrils which, passing upward and posteriorly, joins an orbital ridge at its bifurcation at upper rim of eye, the upper

branch running along top of head and occiput, the lower along upper orbital rim and posteriorly to edge of opercle; mouth U-shaped, the upper lip about opposite a vertical through edge of orbit, the angle of the mouth extending to or beyond pupil; barbel short, not as long as diameter of pupil; teeth villiform; preopercular angle produced backward, rounded, and serrated; gill-membranes forming a wide free fold across isthmus; lateral line following the dorsal contour; scales with 8 to 14 spiny ridges and rather large, 4 series between dorsal spine and lateral line; scales on the breast and ventral portions with but 8 or 9 rows of spines, the rows on body scales but slightly divergent and posteriorly becoming parallel; scales on opercles with 7 strongly divergent rows of spines; ventral surface of head and gill-membranes naked; first dorsal spine minute, the second long and smooth, its length equal

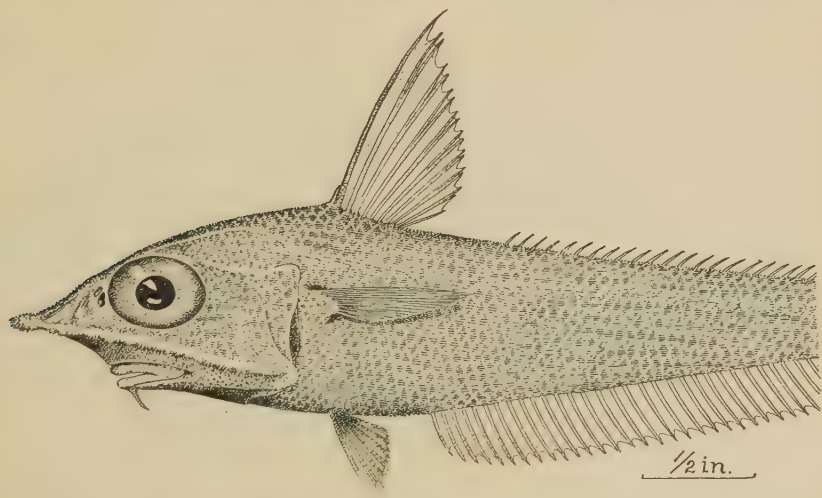


FIG. 11.—*CÆLORHYNCHUS JORDANI*. (From the type.)

to distance from origin of fin to anterior margin of eye; dorsal rays successively shorter; pectoral pointed, nearly 0.5 length of head; ventrals, excluding filamentous first ray, just reach to anal. Color in alcohol light greenish; breast, branchiostegal membranes and throat finely dotted with black and purple; gill-cavity purple, mouth and nostrils colorless.

In general appearance this species approaches *C. kishinouyei* Jordan and Snyder,<sup>a</sup> but may be distinguished from that form by the longer snout, by the smaller number of spinigerous ridges on the scales, and by other sharply defined characters given above.

Described from a specimen 170 mm. long, collected at Kagoshima, June 16, by H. M. Smith.

<sup>a</sup> Proc. U. S. Nat. Mus., XXIII, 1901, p. 376, pl. xx.

*Type*.—Cat. No. 55609, U.S.N.M. Three other specimens were obtained from the same locality June 12; these measured 130, 135, and 140 mm. in length, respectively. We take pleasure in naming this species for Dr. David Starr Jordan in recognition of his prolific studies of the Japanese fish fauna.

Family **PLEURONECTIDÆ**.

**FLOUNDERS.**

173. **PSEUDORHOMBUS CINNAMOMEUS** (Temminck and Schlegel).  
**KAREI.**

Kochi, May 7, one specimen, 255 mm. long.

174. **PSEUDORHOMBUS PENTOPHTHALMUS** Günther.

Kochi, May 11, one specimen, 175 mm. long.

175. **PLEURONICHTHYS CORNUTUS** (Temminck and Schlegel).

Kagoshima and Yamagawa, June 12, 14, and 16, three specimens, 120, 128, and 195 mm. long.

**LAMBDOPSETTA**<sup>a</sup> Smith and Pope, new genus  
(Pleuronectidæ).

Body sinistral, elongate, thin, the dorsal and ventral outlines similar; both sides of body and head covered with fine cycloid scales; lateral line with a small acute arch beginning over branchial slit; mouth small, straight, oblique; fine teeth on blind side of jaws; eyes close together, separated by a high, naked ridge; gill-rakers small, triangular and few; dorsal fin beginning over anterior margin of eye, the 2 anterior rays separated from other; pectoral fins present on both sides; ventrals large and close to anal; ventral of left side with 6 rays, inserted on median ridge, that of right side smaller but with 7 rays, inserted on underside of body.

This genus resembles *Arnoglossus*, but differs from it principally in the short rudimentary gill-rakers, the length of the maxillary, and fin characters. It differs from *Monolene*, a nearly related genus, in the presence of 2 pectoral fins and of cycloid scales on both sides of body.

*Type of genus*.—*Lambdopsetta kitaharæ*.

176. **LAMBDOPSETTA KITAHARÆ** Smith and Pope, new species.

Head 5.75 in length; depth 2.87; eye in head 2.5; pectoral of eyed side 1.4 in head, of blind side 1.6; scales in lateral line 100; dorsal 103; anal 76.

Body very thin and elongated; anterior dorsal profile but slightly stronger than that of lower; caudal peduncle equals diameter of eye; head very short; eyes narrowly separated by a high naked ridge, the

<sup>a</sup> *Lambdopsetta*, from the  $\Lambda$ -shaped bend in the lateral line.



lower one slightly in advance; interorbital ridge beginning as an elevated ridge at the middle of the anterior margin of the lower eye, continued backward and upward along lower margin of the upper eye to the anterior end of lateral line; nostrils short and tubular, close together in angle formed by the union of anterior margins of orbit; mouth small, straight, oblique; maxillary reaching a little past front of lower eye; a curved bony preopercular ridge; posterior end of mandible forming a salient angle; teeth very fine and sharp, on blind side of jaws; gill-rakers few, triangular, minute, and widely separated, 5 or 6 on lower limb of arch and rudimentary ones on upper; dorsal fin beginning opposite anterior margin of upper eye, the first two rays separated from the rest of the fin by a space equal to the diameter of these rays, the first 0.66 length of second; longest dorsal rays contained 1.33 times in head; pectoral of eyed side sharp-pointed, as long as longest dorsal rays and 0.33 longer than that of blind side; caudal

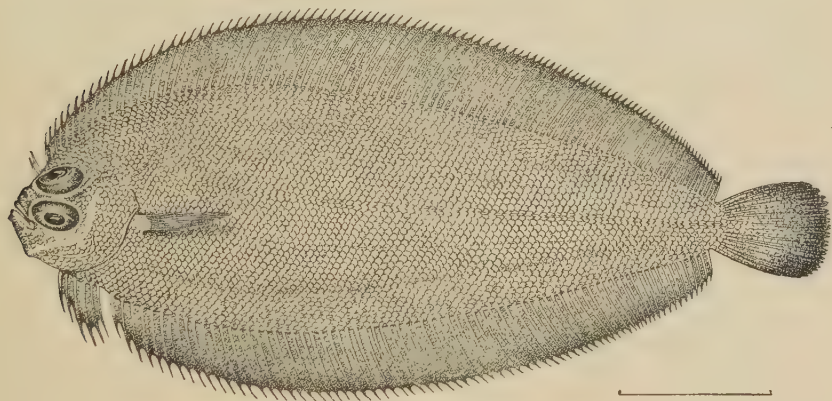


FIG. 12.—*LAMBDOPSETTA KITAHARE*. (From the type.)

broadly rounded, its median rays scaled; ventrals separate, the sinistral one of 6 long rays, upon the median ventral line, the dextral consisting of 7 rays, pushed upon blind side, its base but half length of that of its fellow; anal fin similar to the dorsal; lateral line well developed, with a short, strong, angular arch above pectoral and continuing to the base of the caudal and upon the middle rays of the fin; scales of lateral line smooth and with a deep emargination, the tube straight and extending nearly across the entire scale; scales of body smooth, cycloid, and very deciduous on both sides.

Color in alcohol greenish yellow, the blind side with a decidedly greenish hue; pectoral and ventral fins of blind side colorless, all other fins blackish.

A single specimen, 137 mm. long, from Kagoshima, collected June 16, 1903, by H. M. Smith.

*Type*.—Cat. No. 55612, U.S.N.M.

This species is named for Dr. T. Kitahara, zoologist of the Imperial Fisheries Bureau, in recognition of his studies of the Japanese flounders.

Family SOLEIDÆ.

SOLES.

177. *SOLEA HARTZFELDII* (Bleeker).

Kagoshima, June 16, one specimen, 125 mm. long.

178. *ASERRAGODES KOBENSIS* (Steindachner).

USHINOSHITA (Susaki).

Yamagawa, June 14 and 16, two specimens, 75 and 90 mm. long. No descriptions of this genus refer to the presence of tentacles on chin and snout and about the tubular nostrils on eyed side, which are conspicuous in these examples. A third specimen, 70 mm. long, from Susaki, May 8, differs from the foregoing in the entire absence of tentacles, in having somewhat fewer dorsal and anal rays, and in having the body marked with a few small scattered black spots inclined to form about 4 vertical lines of about 3 spots each.

179. *ZEBRIAS ZEBRINA* (Temminck and Schlegel).

Kagoshima, June 16, one specimen, 175 mm. long, from a depth of 80 fathoms. Abundant.

180. *ZEBRIAS SMITHII* Regan.

Kagoshima, June 12, one specimen, 115 mm. long.

181. *SCÆOPS GRANDISQUAMA* (Temminck and Schlegel).

BETAGARE (Susaki).

Susaki, May 8, one specimen, 82 mm. long; rare. Yamagawa, June 16, three specimens, 78 to 90 mm. long; shore.

182. *CYNOGLOSSUS QUADRILINEATUS* (Bleeker).

Kochi, May 11, one specimen, 200 mm. long; Urado, May 10, one specimen, 90 mm. long. These specimens agree very well with Bleeker's description and figure, having 2 lateral lines on each side and a black smudge on the opercle; depth, 4; head, 5; dorsal, 112; anal, 90; scales, about 100 to division of lateral line.

183. *CYNOGLOSSUS INTERRUPTUS* Günther.

USHINOSHITA (Kochi).

Kochi, May 7, one specimen, 110 mm. long; Kagoshima, June 12, one specimen, 92 mm. long.

184. *ARELISCUS JOYNERI* (Günther).

Kochi, May 11, one specimen, 180 mm. long.

## Family LOPHIIDÆ.

ANGLERS.

## 185. LOPHIOMUS LITULON Jordan.

Kagoshima, June 16, one specimen, 170 mm. long.

## Family ANTENNARIIDÆ.

FROGFISHES.

## 186. ANTENNARIUS TRIDENS (Temminck and Schlegel).

Susaki, May 8, two specimens, 27 and 29 mm. long; Yamagawa, June 16, three specimens, 40, 43, and 50 mm. long.

Proc. N. M. vol. xxxi—06—33





## A NEW COSTA RICAN AMPHIPOD.

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By THOMAS R. R. STEBBING,  
*Fellow of the Royal Society.*

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This new species is interesting on its own account by reason of the perfectly chelate second gnathopods in the male sex, and it makes a further claim to attention by apparently throwing light on Fritz Müller's imperfectly described *Orchestia darwini*. Since Müller made no mention of the female, it remained doubtful whether his species belonged to *Orchestia* or to *Talorchestia*, and a comparison of its second gnathopods with those of *Talorchestia deshayesii* (Audouin) gave some support to the suspicion that it really belonged to the latter genus. Now, however, its close affinity with the new species from Costa Rica makes its position in *Orchestia* by far the more probable hypothesis. A comparison of Müller's figures of two forms of the second gnathopod in the male<sup>a</sup> with the figures and description of that limb here given, while showing the points of agreement between the two species, will also make clear their very definite distinctness.

It may be remarked in passing that the separation of *Talorchestia*, Dana, from Nicolet's *Orchestoidea*, rests on a rather narrow foundation. In the former genus the first gnathopod of the male must be subchelate, in the latter it must be simple. But there are subtle gradations, and in consequence a difference of opinion sometimes arises as to whether the difference in nature is present or absent. It is not necessary here to argue the point.

### Family TALITRIDÆ.

#### ORCHESTIA COSTARICANA, new species.

#### Plate XI.

The new *Orchestia* is of slender structure, strongly compressed, with a shining surface. The second and third side plates have the lower hind angles a little produced backward. The front lobe of the fifth side plate is as deep as the plate preceding it. The quadrate postero-

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<sup>a</sup> Facts for Darwin, translated by Dallas, 1869, p. 26.

lateral angles of the second and third pleon segments are minutely produced.

The eyes are dark, irregularly rounded, the interval between them less than the diameter of the eye and in large specimens reduced to a very narrow space. The first antennæ do not reach the end of the penultimate joint of the peduncle of the second pair. They have a five-jointed flagellum subequal in length to the peduncle, of which the first and second joints are subequal, broader but not much longer than the third. The second antennæ are slender, with a flagellum of about twenty joints, nearly as long as the peduncle, in which the last joint is considerably longer than the penultimate, more so in the male than in the female. The mouth parts are on the whole all of the character usual in the genus. In the first maxillæ no palp could be detected, but in the female a microscopic notch was seen in the position proper to the base of the palp.



FIG. 1.—*ORCHESTIA COSTARICANA*, MALE.

The first gnathopod of the male has a small pellucid prominence on the fourth joint distally, and the inner margin of the fifth and sixth joints boldly produced, the distal projection of the sixth much narrower than that of the fifth, but extending beyond the little spinule-fringed palm, which is matched by the small acute finger. In the female this limb is differently constructed, with a narrower second joint and no pellucid bulbous prominences. As in the male, the fifth joint is considerably longer than the sixth. The latter is narrow, fringed on both margins with spines, and expands slightly to a small concave palm, beyond which the small curved finger extends.

The second gnathopod of the male has a long, slender second joint, having on the proximal part of the front margin two little tubercles near together, equal or very unequal. The third joint is short, with a distal projection in front, the fourth joint of about the same length,

the fifth apparently quite coalesced with the sixth and consisting of a narrow triangular piece lying alongside the oblong fourth joint. The sixth joint proper has an oblong trunk about twice as long as broad, with the hind margin distally produced into a slender nearly straight thumb about two-thirds the length of the trunk. The finger, somewhat stronger than the thumb, when closed overlaps the pointed apex of the thumb with its own curved and blunt apex, and brings its bulging middle part into contact with the spinulose distal half of the thumb, leaving an irregularly oval gap between the proximal confronting edges of this true chela. It will be noticed in the enlarged figures of the second gnathopod of *Orchestia darwini* that the proportions and outline of the trunk are quite different from those of the present species, and also that the finger in closing upon the thumb there presents an arrangement which is scarcely more than subchelate. The second gnathopod of the female is not exceptional. The fourth



FIG. 2.—*ORCHESTIA COSTARICANA*, FEMALE.

joint has a pellucid boss, the fifth a similar median projection of the free hind margin, and the sixth is broadly produced beyond the exceedingly small chela-forming finger of this delicate structure. The pereopods in both sexes are slender, the first longer than the second, of which the finger is not constricted; the third much shorter than the fourth; and the fourth than the fifth. The second joint of the third pereopod is rather narrowly oval; that of the fourth larger but similar; that of the fifth again larger, but also much broader proximally than distally, with the lower margin straight. In this pair and to a less degree in the third and fourth pairs the sixth joint is considerably longer than either of the two preceding joints. The branchiae are of the usual slender character, some of them lobulate.

The pleopods are very narrow. The first uropods have the rami nearly equal to the peduncle. In the much shorter second uropods the rami are equal one to the other and to the peduncle. The third

uropods have a very short ramus on a somewhat longer and much stouter peduncle. The telson is slightly bilobed.

*Length*.—The largest males and females are about 9 mm. long.

*Habitat*.—Numerous specimens were collected by Prof. J. F. Tristan and Prof. P. Biolley in January, 1906, at Boca Jesus Maria, Costa Rica, on mangroves in the mud under trunks of trees.

*Cotypes*.—Cat. No. 32688, U.S.N.M.

The specific name refers to the place of capture.

#### EXPLANATION OF PLATE XI.

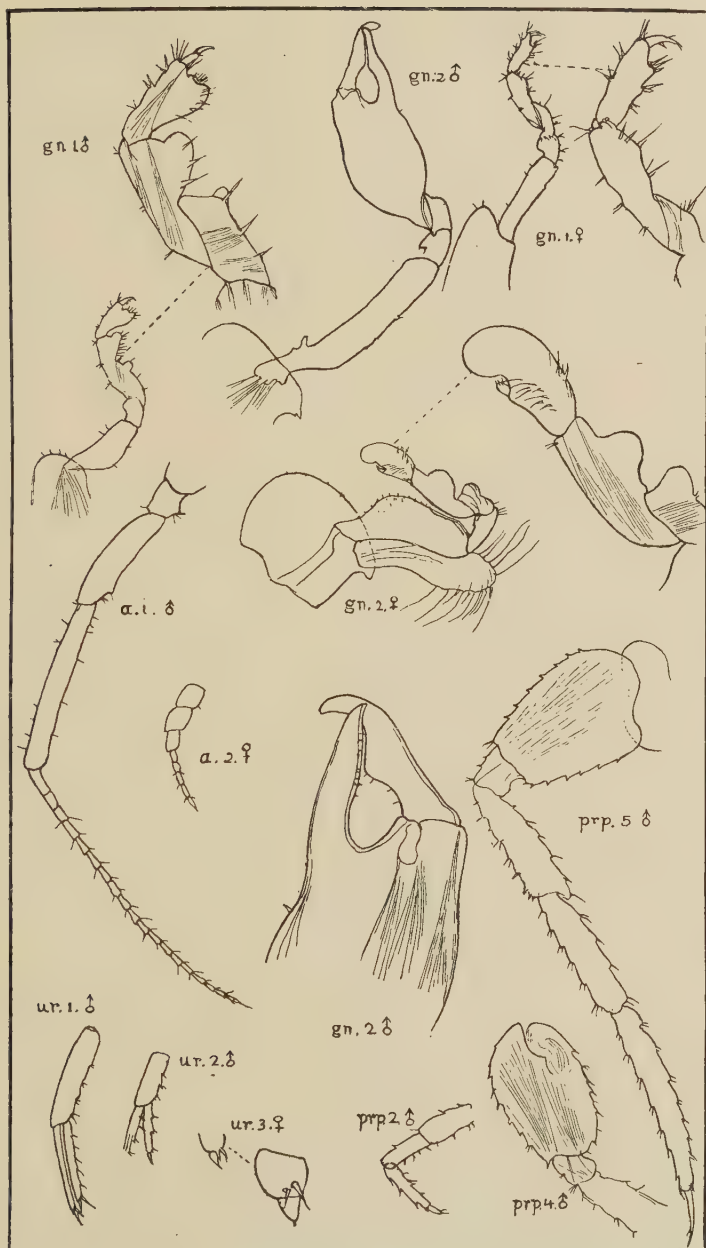
*a. s.* female, *a. i.* male. Upper antenna of female, lower antenna of male.

*gn.* 1, 2, male; *gn.* 1, 2, female. First and second gnathopods of male and female, with portions of the same more highly magnified.

*prp.* 2, 4, 5, male. Parts of second and fourth and whole of fifth peræopods of male.

*ur.* 1, 2, male; *ur.* 3, female. First and second uropods of male, and third uropod of female, the last also more highly magnified.





ORCHESTIA COSTARICANA.

FOR EXPLANATION OF PLATE SEE PAGE 504.



FISHES COLLECTED IN THE PHILIPPINE ISLANDS BY  
MAJ. EDGAR A. MEARNS, SURGEON, U. S. ARMY.

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By BARTON W. EVERMANN,

*Curator, Division of Fishes,*

AND

ALVIN SEALE,

*Of Palo Alto, California.*

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While stationed in the Philippines during 1904, Maj. Edgar A. Mearns, surgeon, U. S. Army, made a small collection of fishes, chiefly at Manila.

The collection contains 17 specimens (representing 9 species) from Manila, 4 specimens (3 species) from Jolo, Sulu Archipelago, 2 specimens (1 species) from Siassi, Siassi Island, and 10 specimens (4 species) from Caldera Bay at Zamboanga, Mindanao Island; the total number of species being 17, represented by 33 specimens.

The collection, though small, is of interest in that it contains three new species and that no specimens had been previously obtained from Jolo, Siassi, or Zamboanga.

The types of the new species and a series of specimens of all the other species are deposited in the U. S. National Museum.

Family CHANIDÆ.

I. CHANOS CHANOS (Forskål).

*Mugil chanos* FORSKÅL, Desc. Anim., p. 74, 1875, Red Sea.

*Chanos chanos*, JORDAN and EVERMANN, Fishes Hawaiian Islands in Bull. U. S. Fish Comm., XXIII, 1903 (1905), Pt. 1, p. 56, fig. 10.

Head 3.75 in length (not including opercular membrane); depth 4; eye 3.50 in head; snout 3.85; interorbital 3; D. II, 14; A. I, 9; scales 85 to end of caudal vertebræ; membranes entirely united across isthmus; gillrakers very fine and crowded together, more than 100 on lower limb, their length 1.25 in pupil; no pharyngeal teeth; origin of dorsal midway between tip of snout and caudal; origin of ventral

midway between base of caudal and posterior margin of eye. Color in spirits, silvery.

One specimen from Manila, Cat. No. 55602, U.S.N.M.; length 5.55 inches.

### Family HEMIRAMPHIDÆ.

#### 2. HYPORHAMPHUS QUOYI (Cuvier and Valenciennes).

*Hemiramphus quoyi* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 26, New Guinea.—GÜNTHER, Cat., V, p. 262.—BLEEKER, Atlas, VI, pl. CCL, fig. 3.

Head (to tip of upper jaw) 4.20 in length; depth 8.75; lower jaw beyond tip of upper, 6.25 in length without caudal; D. 15; A. 15; interorbital 4 in head; snout 3; width of upper jaw greater than its length; origin of dorsal directly above origin of anal; origin of ventrals midway between base of caudal and middle of eye.

Color in spirits, silvery, a blue line on side; three narrow dusky lines on back.

One specimen from Manila, Cat. No. 55604, U.S.N.M.; length 4 inches.

### FAMILY MUGILIDÆ.

#### 3. MUGIL SUNDANENSIS Bleeker.

*Mugil sundanensis* BLEEKER, Sumatra, II, 1853.—GÜNTHER, Cat., III, p. 425.

Head 4.20 in length; depth 4.20; eye 3.50 in head; free portion of eye 5.20; snout 6; interorbital 2.50; D. IV, 9; A. 9; scales 29 to end of caudal vertebræ; adipose eyelid strongly developed; caudal emarginate; origin of dorsal midway between tip of snout and end of caudal vertebræ; origin of anal midway between end of caudal vertebræ and origin of ventrals, being somewhat in advance of origin of soft dorsal; pectoral 1.50 in head.

Color in spirits, brownish; dorsal and anal with wash of dusky; no dusky spot at axil of pectoral; an indistinct dusky area or stripe along middle of side.

Three specimens from Manila, Cat. No. 55,606, U.S.N.M.; length 4.50 to 6 inches.

#### 4. LIZA TROSCHELII (Bleeker).

*Mugil troschelii* BLEEKER, Nat. Tijdschr. Ned. Ind., XVI, p. 277.—GÜNTHER, Cat., III, p. 448.

Head 3.75 in length; depth 3.75; eye 3.75 in head; snout 5.50; interorbital 2.20; D. IV, 9; A. III, 9; scales 34 to end of caudal vertebræ; no adipose eyelid; caudal emarginate; origin of dorsal slightly nearer end of caudal vertebræ than to tip of snout; origin of anal



nearer end of caudal vertebræ than to origin of ventrals, being under origin of soft dorsal: pectoral about equal to length of head.

Color in spirits, yellowish brown; soft dorsal and anal with slight wash of dusky; a distinct black spot at upper axil of pectoral.

Five specimens from Manila; length 3.20 to 5.75 inches.

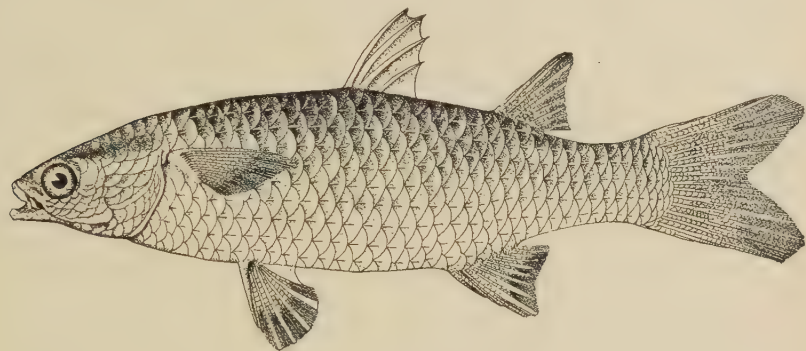


FIG. 1.—LIZA TROSCHELII.

## FAMILY OPHICEPHALIDÆ.

### 5. OPHICEPHALUS STRIATUS Bloch.

*Ophicephalus striatus* BLOCH, Ichth., VII, p. 141, 1793, Malabar.

*Ophiocephalus striatus*, GÜNTHER, Cat., III, p. 474, 1861.

Head 3 in length; depth 5.50; eye 8 in head; snout 5.35; interorbital 4.10; D. 40; A. 26; scales 5-54-7; scales on head large.

Color in spirits, brown; belly yellowish white with a few scattered brown dots or spots, a brown line back from angle of mouth; fins brown, except ventrals and tip of pectoral, which are yellowish, with brown dots.

Two specimens from Siassi, Siassi Island; length 4 and 8.75 inches (Field Nos. 98 and 100).

## Family LUTIANIDÆ.

### 6. TERAPON JARBUA (Forskål).

*Scizena jarbua* FORSKÅL, Desc. Anim., p. 50.

*Therapon servus*, GÜNTHER, Cat., I, 1859, p. 278.

*Therapon jarbua*, DAY, Fishes India, p. 69, pl. XVIII, fig. 4.

Head 3 in length; depth 3; eye 3.30 in head; snout 3.20; D. XII, 10; A. III, 9; scales 85; margin of preopercle toothed, the teeth larger at angle; a strong spine from posterior margin of opercle; pre-orbital denticulate; caudal emarginate.

Color in spirits, yellowish white, with three dark longitudinal stripes, which are concave to the dorsal surface; caudal with oblique dark bands; dorsal with dusky blotch.

Three specimens from Manila, Cat. No. 55605, U.S.N.M.; length 2.50 to 3.75 inches.

## Family HÆMULIDÆ.

## 7. POMADASIS ARGENTEUM (Forskål).

*Sciæna argentea* FORSKÅL, Descr. Anim., p. 51.

*Pristipoma argenteum*, CUVIER and VALENCIENNES, Hist. Nat. Poiss., V, p. 249.—GÜNTHER, Cat., I, p. 291.—DAY, Fishes India, p. 79, pl. VIII, fig. 3.

Head 2.85 in length; depth 2.75; eye 3.20 in head; snout 3.20; interorbital 4.20; D. XII, 13; A. III, 8; scales 49; preopercle strongly denticulate; opercle with two flat spines.

Color in spirits, yellowish white; numerous narrow dusky rows of brown dots on upper half of body.

One specimen from Manila, Cat. No. 55601, U.S.N.M.; length 3 inches.

## 8. PLECTORHYNCHUS CRASSISPINUS (Rüppell).

*Diagramma crassispinum* RÜPPELL, N. W. Fische, p. 125, pl. xxx, fig. 4.—DAY, Fishes India, p. 78, pl. xx, fig. 4.

Head 2.55 in length; depth 2.10; eye 3.75 in head; snout 3; interorbital 4.1; D. XIV, 16; A. III, 7; pores about 53 in lateral line to end of caudal vertebræ; head scaled; preopercle denticulate; opercle with two flat spines; second anal spine long and strong, 2 in head; caudal rounded; teeth in jaws, none on vomer or palatines.

Color in spirits, dusky grayish; caudal white; anal, ventrals, and soft dorsal black, the soft dorsal and anal with narrow margins of white.

One specimen from Manila, Cat. No. 55603, U.S.N.M.; length 2.1 inches.

## Family SPARIDÆ.

## 9. LETHRINUS MAHSENOIDES Bleeker.

*Lethrinus mahsenoides* BLEEKER, Verh. Bat. Gen., XXIII, Spar., p. 15.—GÜNTHER, Cat., I, p. 464.

Head 2.90 in length; depth 2.50; eye 3.75 in head; snout 1.65; interorbital 3; preorbital 2.50; D. X, 9; A. III, 8; scales 6–48–15; teeth in a single row, the 4 anterior canines of each jaw rather large, 4 molar teeth of upper jaw bicuspid; a single bicuspid molar in lower jaw, the remaining teeth rounded or conical; lips thick; caudal forked; ventrals extending past vent.

Color in spirits, grayish with slight tint of green; the center of scales yellowish; dorsal slightly clouded with dusky; tip of caudal dusky; axil of pectoral dusky; otherwise fins without markings.

One specimen 10 inches long from Jolo, Sulu Archipelago.

10. *LETHRINUS MCENSII* Bleeker.

*Lethrinus mcensii* BLEEKER, Nat. Tijds. Ned. Ind., IX, 1855, p. 435.—GÜNTHER, Cat., I, p. 455.

Head 2.90 in length; depth 3; eye 4 in head; snout 1.90; preorbital 2.50; interorbital 3.20; D. X, 9; A. III, 8; scales 649-14; teeth in single row, the 4 upper canines of upper jaw largest, curved; 6 flat gillrakers on lower limb.

Color in spirits, dirty grayish, with about 6 dusky bands over back more narrow than interspaces; dorsal, caudal, and anal slightly clouded with dusky; other fins yellowish; some indistinct dusky bars on body, alternating with the bands over back.

One specimen from Jolo, 9 inches long.

## Family ACANTHURIDÆ.

11. *HEPATUS MATOIDES* (Cuvier and Valenciennes).

*Acanthurus matoides* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 150, Oualan.

*Acanthurus annularis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 153, Ile de France.

*Acanthurus blochii* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 153, Ile de France.

*Hepatus matoides*, JORDAN and EVERMANN, Bull. U. S. Fish Comm., XXIII, 1903 (1905), p. 387 (Honolulu).

Head 3.45 in length; depth 1.75; eye 4.50 in head; snout 1.35; interorbital 2.75; D. IX, 25; A. III, 26; teeth flat, crenulate; spines on side of caudal peduncle small, equal to two-thirds of eye; caudal lunate.

Color in spirits, uniform black, without lines; fins uniform black without lines, except pectoral, which is bright yellow on distal half of fin.

Another specimen, probably the young of this species, has the following characters:

Head 3 in length; depth 1.75; eye 2.75 in head; snout 1.75; interorbital 2.75; D. IX, 24; A. III, 24; spines on caudal peduncle small, about one-half of eye; lateral line with a long low curve, becoming straight under posterior part of soft dorsal; teeth flat, crenulate.

Color in spirits, uniform black; pectoral yellow, the caudal with a slight trace of whitish at base.

One specimen 1.75 inches long from Zamboanga and one 8.75 inches long from Jolo.

## Family PLATYCEPHALIDÆ.

## 12. PLATYCEPHALUS INSIDIATOR (Forskål).

*Cottus insidiator* FORSKÅL, Descr. Anim., p. 25, 1775, Red Sea.

*Platycephalus insidiator*, GÜNTHER, Cat., II, p. 175, 1860.

Head 3.20 in length; depth 11; width of head at opercle 1.50 in its length; eye 6.5 in head; snout 3.75; interorbital 8; D. VII, 12; A. 13; scales about 76; lateral line unarmed; two spines at angle of preopercle, their length 1.50 in eye; interorbital concave, scaled; spines of head inconspicuous.

Color in spirits, brownish above, with indistinct dusky blotches or mottlings; white below.

One specimen from Manila, Cat. No. 55599, U.S.N.M.; length 7.50 inches.

## Family TETRAODONTIDÆ.

## 13. CANTHIGASTER COMPRESSUS (Procé).

*Tetraodon compressus* PROCÉ, Bull. Soc. Philom., 1822, p. 130.

*Tetraodon striolatus*, GÜNTHER, Cat., VIII, p. 304.

Head 2.45 in length; depth 2.10; eye 2.75 in head; snout 2; interorbital 3; D. 9; A. 8; nostrils in shallow tube; caudal rounded.

Color in spirits, grayish; bluish above with blue lines from eye and on head; a large black ocellus at base of dorsal fin; fins yellowish; caudal with whitish band.

One small specimen from Zamboanga, Mindanao; length 1 inch.

## 14. TETRAODON IMMACULATUS Bloch and Schneider.

*Tetraodon immaculatus* BLOCH and SCHNEIDER, p. 507.—DAY, Fishes India, p. 704, pl. CLXXXIII, fig. 4.—GÜNTHER, Cat., VIII, p. 291.

One specimen from Manila, Cat. No. 55600, U.S.N.M.; length 4.80 inches.

This specimen belongs to variety A of Günther's Catalogue (VIII, p. 292), the body without bands or spots, the upper posterior portion with a slight tint of dusky; posterior part of caudal dusky; fins rounded; D. 10; A. 9; head 2.75 in length; eye 4 in head; snout 2.10; interorbital convex equal to snout; length of caudal equal to its distance from origin of dorsal; body spinate, except on snout and posterior portion.

## Family GOBIIDÆ.

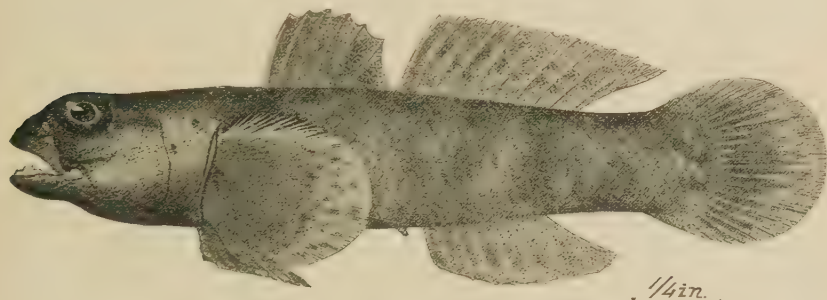
## 15. MAPO MEARNSI Evermann and Seale, new species.

Head 3.30 in length; depth 5; width of head much greater than its depth, which is 1.30 in its length; cheeks prominent; D. VI, 10; A. 9; scales 38, about 10 in vertical series; head without scales except on the



crown; eye 4 in head; snout 4; interorbital about equal to pupil; about 14 of the upper pectoral rays detached and silky; tongue emarginate, free anteriorly; teeth small, in several rows.

Color in spirits, greenish or grayish; some very indistinct dusky markings on middle line of side; no white dots; dorsal blotched with dusky; a dusky blotch on posterior part of spinous dorsal.

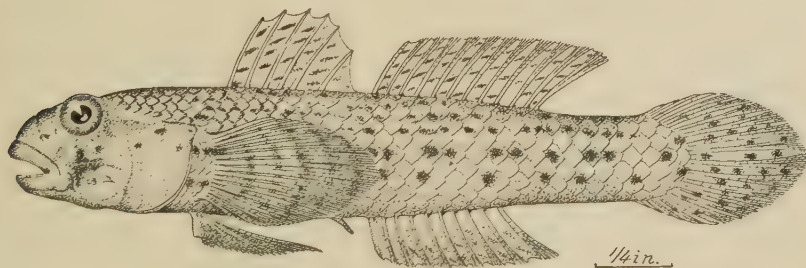
FIG. 2.—*M. PO MEARNSEI*.

Two specimens, the type, Cat. No. 55624, U.S.N.M., a specimen 2.5 inches long, from Zamboanga, Mindanao, and a cotype, No. 1495, Bureau of Fisheries, a specimen 1.55 inches long, from same place.

We take pleasure in naming this interesting species for Dr. Edgar A. Mearns, U. S. Army, who collected the type.

16. *GobiUS CALDERÆ* Evermann and Seale, new species.

Head 3.75 in length; depth 5.20; eye 4 in head; snout 3.50; interorbital equal to pupil; D. VI, 11; A. 10; scales 26, 9 in vertical series; tongue adnate, merely truncate, scarcely, if at all, emarginate; width

FIG. 3.—*GobiUS CALDERÆ*.

of head 1.20 in its length; depth of head 1.75; teeth in jaws in several series; body firmly scaled; head naked, except on nuchal region; caudal rounded; ventral stout, disk-like.

Color in spirits, yellowish with tint of green; about 6 longitudinal black bands on side, the 2 lower ones broken up with about 8 black spots; cheek with dark lines, 2 of which extend into the yellow color-

ing on underpart of head; no white dots on body; fins with dark dotted lines; ventral dusky; anal very indistinctly marked with dusky; no rows of wart-like mucous pores on cheek. Each of the specimens has a dark spot on center of base of ventrals.

Similar to *G. ornatus*, but with more robust body and blunter head. The markings are also slightly different.

Four specimens from Caldera Bay, Zamboanga, Mindanao; length 2.10 to 2.75 inches.

*Type*.—Cat. No. 53625, U.S.N.M.; length 2.50 inches.

#### Family BLENNIIDÆ.

##### 17. *SALARIAS ZAMBOANGÆ* Evermann and Seale, new species.

Head 4.9 in length; depth 5.25; eye 4 in head; D. XII, 21; A. III, 22; lateral line short, ending under posterior third of dorsal; a distinct nuchal crest present; a fringed tentacle over eye; a small bifid tentacle at nostril; no nuchal tentacle; no posterior canine; dorsal fin slightly incised; anal connected by membrane to base of caudal rays.

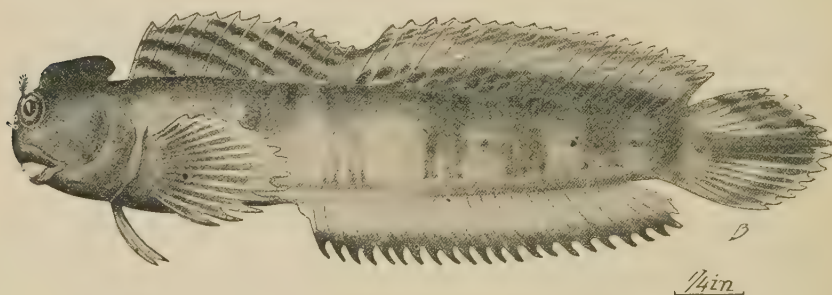


FIG. 4.—*SALARIAS ZAMBOANGÆ*.

Color in spirits, bluish olivaceous on back and side; underparts paler; about 7 broad double dark purplish bands over back and down side; middle and lower part of side posteriorly with two rows of small roundish black spots; head bluish; dorsal fin black on submargin, below which are short oblique white lines; lower half dark purplish with a series of white blotches along base; anal dark edged, the basal three-fourths lighter; caudal mottled with dark; pectoral and ventrals grayish.

This species is related to *S. meleagris*, from which it differs in the absence of the white spots on side, the less incised dorsal fin, the union of the dorsal fin with the caudal, and the absence of a nuchal tentacle.

Three specimens from Zamboanga, Mindanao; length 2.10 to 2.85 inches.

*Type*.—No. 55623, U.S.N.M., a specimen 2.85 inches long. Cotypes, No. 10007, Stanford University; and No. 1496, Bureau of Fisheries.

## NOTES ON A NEWLY MOUNTED SKELETON OF MERYCOIDODON,<sup>a</sup> A FOSSIL MAMMAL.

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By CHARLES W. GILMORE,

*Of the Department of Geology.*

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During 1897, while engaged in field work for the U. S. Geological Survey, Mr. N. H. Darton collected from the Oligocene deposits of South Dakota a very complete skeleton of the small Oreodont, *Merycoidodon gracilis*.

The portions found consist of a poorly preserved skull and jaws; the vertebral column (articulated) from the atlas to the fourth caudal, one median caudal, twelve ribs of the right side and half of those of the left, three segments of the anterior portion of the sternum; both femora, both tibæ, right patella, articular portions of both scapulæ, both humeri (the left one lacking the distal end); proximal ends of both ulnæ, both radii (one lacking the distal portion); left scaphoid, lunar, and unciform; second, third, and fourth (latter lacking the distal end) metacarpals; several phalanges, including one ungual of the same foot; astragalus and calcaneum of the right hind foot; a portion of the hyoid arch.

This specimen (Cat. No. 2455), which was freed from the matrix and mounted by the writer, has recently been placed on exhibition in the U. S. National Museum. (See Plate XII.) So far as the writer is aware, it is the first example of this particular species to be thus exhibited.

The poorly preserved skull and jaws of Cat. No. 2455 have been replaced by the homologous parts of a more complete but somewhat smaller individual, Cat. No. 136, U.S.N.M. The latter elements are of peculiar interest as having been the subjects of study and illustration by Dr. Joseph Leidy as early as 1869 in his *Extinct Mammalian Fauna of Dakota and Nebraska*.<sup>b</sup> The remainder of the skeleton pertains to

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<sup>a</sup> Commonly known as Oreodon. See Hay, Bull. No. 179, U. S. Geol. Surv., p. 665.

<sup>b</sup> Jour. of the Acad. of Nat. Sci. (2), VII, 1869, p. 94, pl. vi, figs. 2 and 3.

Cat. No. 2455, except those parts which were missing; these have been restored in plaster. The lacking foot elements have been restored after a fore and hind foot of this species kindly placed at our disposal by Dr. H. F. Osborn, of the American Museum of Natural History, New York City. The tail has been given the same number of caudals as found in *M. culbertsoni*, a larger but closely allied species found in the same geological horizon. The vertebral formula of the species, as shown by this specimen, is as follows: Seven cervicals, 14 dorsals, 7 lumbar, 4 sacral, and 19 (?) caudals. The vestigial clavicle present in *M. culbertsoni* and *Agriochærus* was not found with this specimen.

This species was characterized first in a verbal communication by Doctor Leidy to the Academy of Natural Sciences of Philadelphia in 1851.<sup>a</sup> It is the smallest representative of the Oreodonts, the skull being about the size of that of the red fox. The teeth show the animal to be allied to the ruminants, but it had many points of resemblance to the pigs, and Leidy has spoken of them as "ruminating hogs." The stout tusks indicate that, like the pigs, the animal was more disposed to fight than to run from its enemies.

Although the skulls and bones of the Oreodonts are among the most frequent fossils found in the White River Bad Lands, their skeletons are not better represented in the several museums than many of the more rare forms.

Their remains have been found only in North America.

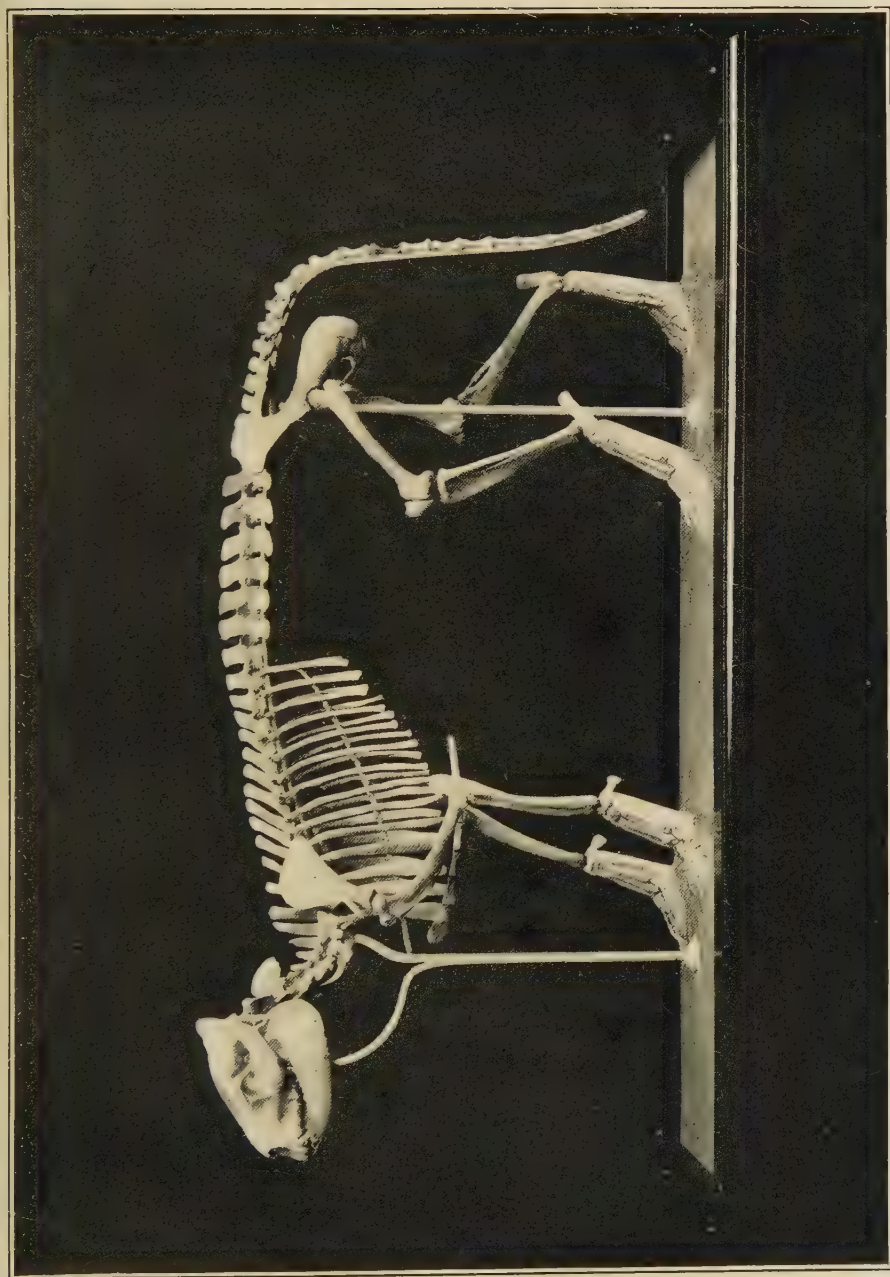
It seems quite probable, after a superficial examination of several individuals in the collections of this Museum, that there is more than one species of the small Oreodonts, and a careful study of a good series would undoubtedly be rich in scientific results.

The skeleton as mounted is 27 inches (690 mm.) in length and stands 12½ inches (320 mm.) high at the shoulder.

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<sup>a</sup> Proc. Acad. Nat. Sci. Phila., V. 1851, p. 239.





SKELETON OF MERYCOIDODON GRACILIS.

FOR DESCRIPTION SEE PAGE 513.



NOTES ON A COLLECTION OF FISHES FROM PORT  
ARTHUR, MANCHURIA, OBTAINED BY JAMES FRANCIS  
ABBOTT.

---

By DAVID STARR JORDAN and EDWIN CHAPIN STARKS.

*Of Stanford University, California.*

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During the summer of 1904, Dr. James Francis Abbott, now of Washington University, St. Louis, Missouri, then professor in the Japanese Naval Academy at Etájima, obtained a collection of fishes from the harbor of Port Arthur, in Manchuria. The species in this collection are enumerated in the present paper. The specimens are divided between the United States National Museum and the museum of Stanford University. The accompanying plates are the work of Mr. William S. Atkinson.

The fauna of Port Arthur is in general not very different from that of the west coast of Japan, a few distinctively Chinese species being, however, represented.

Five species in this collection seem to be new.

Family RAJIDÆ.

1. RAJA MEERDERVOORTI Bleeker.

One specimen, a mature male.

2. RAJA KENOJEI Müller and Henle.

Three specimens.

Family CLUPEIDÆ.

3. HARENGULA ZUNASI (Bleeker).

Several specimens preserved. The depth is rather variable even among specimens of the same size, running from 3 to  $3\frac{1}{2}$  in the length to base of caudal. Günther describes the depth as being equal to the length of the head. In our specimens the length of the head is contained from  $1\frac{1}{3}$  to  $1\frac{2}{3}$  in the depth, agreeing very well with the plate published by Schlegel.<sup>a</sup> Bleeker describes the type as having teeth on the palatine, but Günther later examining the same specimen

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<sup>a</sup> Fauna Japonica, pl. cvii, fig. 1.

reports the palatine teeth absent. There are, however, fine teeth on the palatine, which are scarcely visible until the mouth parts have been dried.

### Family ENGRAULIDÆ.

#### 4. COILIA NASUS Schlegel.

About 100 specimens are in the collection. These agree very well with the plate of this species published by Schlegel. Anal rays, 80 to 82; spine bearing scutes on ventral region, 42 to 43; scales, 60 to 63; scales in front of dorsal on the median line, 11 to 13; distance from tips of snout to front of dorsal,  $2\frac{2}{3}$  to 3 times; combined length of eye and snout in postorbital part of head,  $1\frac{1}{3}$ . In the last character Schlegel's plate agrees better with *C. ectenes*.

#### 5. COILIA ECTENES Jordan and Seale.

Six specimens, among about a hundred of *C. nasus*. *Coilia ectenes* differs from *Coilia nasus* and from other species in having more anal rays. It is described as having 123 anal rays. This is probably a misprint for 113 as the figure of the type shows but 115, and the sole cotype has 106. Our Port Arthur specimens have from 96 to 106 anal rays. Günther in his description of *C. nasus*<sup>a</sup> evidently included this species with the other. *Coilia ectenes* differs further from *C. nasus* in having 48 or 49 ventral scutes; 71 to 73 scales in a lateral series; 18 to 20 scales before dorsal; the distance from tip of snout to occiput contained in distance from tip of snout to front of dorsal  $3\frac{1}{3}$  to  $3\frac{2}{3}$  times; and the combined length of eye and snout contained in postorbital part of head  $1\frac{1}{4}$  times.

### Family SALANGIDÆ.

#### 6. SALANX HYALOCRANIUS Abbott.

One specimen.

### Family EXOCETIDÆ.

#### 7. HEMIRAMPHUS SAJORI Schlegel.

One specimen.

### Family MUGILIDÆ.

#### 8. MUGIL CEPHALUS Linnæus.

(*Mugil œur* FORSKÅL).

One specimen.

### Family STROMATEOIDIDÆ.

#### 9. STROMATEOIDES CINEREUS (Bloch).

A single large specimen 28 cm. in length. Depth,  $1\frac{1}{2}$  in length to base of caudal; pectoral, 3; anterior lobe of dorsal, 4; lower caudal lobe,  $2\frac{1}{2}$ ; upper lobe,  $3\frac{1}{2}$ .

<sup>a</sup> Cat. Brit. Mus., VII, p. 405.



## Family SERRANIDÆ.

10. *LATEOLABRAX JAPONICUS* (Cuvier and Valenciennes).

Several small specimens collected, the largest 16 cm. in length. They differ from specimens from Japan in being generally darker and in having the spots on body larger and much more conspicuous. In the Japanese specimens the spots are more scattered, comparatively faint or sometimes almost wholly absent. No other differences are appreciable. A large specimen from Port Arthur, 55 cm. long, has no spots on the body but several rows of spots on the membrane of the dorsal (the small ones have 2 or 3 rows). Specimens from Japan of various sizes show this character to be variable, though the larger specimens usually have the dorsal spots more numerous.

## Family SPARIDÆ.

11. *PAGRUS ARTHURIUS* Jordan and Starks, new species.

Head  $3\frac{1}{2}$  in length to caudal base; depth  $2\frac{1}{2}$ . Eye 4 in head,  $1\frac{1}{2}$  in snout. Snout  $2\frac{1}{4}$  in head; interorbital space  $3\frac{3}{5}$ ; maxillary  $2\frac{3}{5}$ . Dorsal rays, XII, 10; anal, III, 8; scales 57.

Upper anterior profile from front of dorsal to tip of snout a moderate even curve with a scarcely distinguishable protuberance in front of eye. Lower jaw slightly included, its tip not square, but rounded to a blunt point at base of teeth. Maxillary reaching to below front of pupil. Two large canines on each side of front of upper jaw; 3 on lower, growing smaller anteriorly; behind these a couple of rows of very small conical teeth; a single molar on posterior end of lower jaw in front of which are 2 rows of similar teeth, giving place in front to the fine conical teeth behind canines; 7 teeth in the outer row, the third from the front slightly longer and sharper than the others; 4 large molars on inner row with smaller molars in front, which pass gradually into the small conical teeth; 7 molars in outer row on upper jaw growing conical anteriorly and giving place abruptly to the small conical teeth; 3 or 4 large molars on inner row posteriorly, changing abruptly at about middle of side of jaw to very small teeth. Preorbital at end of maxillary equal in width to the vertical diameter of eye. Gill rakers short and rather sharp posteriorly, the front ones blunt; the longest equal to half diameter of pupil; 9 developed on lower limb of arch.

Ten scales in an oblique series running downward and backward from front of dorsal to lateral line; 16 in a series upward and forward from front of anal. Seven rows of scales on cheek; the subopercle and interopercle closely scaled; separated from the scales on cheek by a broad naked margin on posterior part of preopercle. Top of head with fine crowded scales to opposite front of eye.

Fourth dorsal spine  $2\frac{1}{3}$  in head; tip of third broken, but apparently it was shorter than fourth, the spines nowhere abruptly shorter or longer. Soft dorsal rays shorter than the longest spines, but longer than anal rays; second anal spine as long as third and about equal to it in thickness; tip of pectoral reaching to opposite third anal spine. Ventrals not reaching to vent. Caudal rather deeply forked; when widely spread, its edge is evenly concave, the depth of the curve equal to the diameter of the eye.

Color in spirits, silvery with a few fine points scattered over it, only slightly darker above; top of head and snout brown; a little red color remains on breast, and it is probable that the species is red in life.

This species is related to *Pagrus major* (Schlegel) and *Pagrus ruber* Doderlein, having two rows of molars. It has a much smaller eye, a

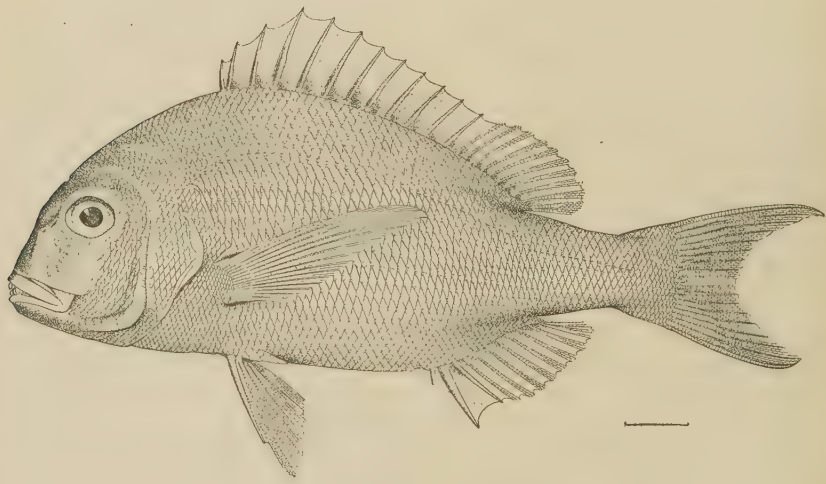


FIG. 1.—*PAGRUS ARTHURIUS*.

longer snout, and a wider preorbital than the latter. *Pagrus ruber* is described as having the eye contained  $2\frac{2}{3}$  times in the head; the snout 3; the width of the preorbital  $1\frac{1}{3}$  to  $1\frac{2}{3}$  in the eye. *Pagrus arthurius* differs from *Pagrus major* in having a much larger eye, a narrower preorbital, a shorter snout, the top of the head scaled to front of eye and the caudal more deeply forked.

*Type*.—One specimen 34 cm. in length, No. 9880, Stanford University.

#### Family SCLÆNIDÆ.

##### 12. *CORVULA ARGENTATA* (Houttuyn).

Several specimens collected. They are identical with Japanese specimens in all essential characters.

##### 13. *COLLICHTHYS FRAGILIS* Jordan and Seale.

About 35 specimens collected.

14. *COLLICHTHYS NIVEATUS* Jordan and Starks, new species.

Head  $3\frac{1}{2}$  in length to base of caudal; depth 3. Eye  $4\frac{1}{4}$  in head; snout  $4\frac{1}{4}$ ; maxillary  $1\frac{2}{3}$ ; interorbital space  $2\frac{2}{3}$ . Dorsal, IX, 24; anal, II, 12.

Body somewhat shorter and deeper than in *Collichthys fragilis*. Lower jaw projecting, its lip entering upper profile of head; gape very oblique, on an angle of about 45 degrees with axis of body. Teeth on mandible larger, more curved and in fewer rows than in *Collichthys fragilis*. On posterior part they are in a single row and in 2 rows in front (2 or 3 teeth at extreme tip in a third row); in the latter species they are in 2 rows posteriorly and in 3 or more rows in front. Teeth on premaxillary not noticeably different in the two species; in broader bands than on mandible; much smaller than mandibular teeth in *Collichthys niveatus*; little if any smaller in *Collich-*

FIG. 2.—*COLLICHTHYS NIVEATUS*.

*thys fragilis*. No teeth on vomer or palatines. Maxillary wide and slipping under preorbital for its full length; its posterior end reaches to the verticle from posterior edge of orbit. Anterior end of premaxillary on a level with middle of eye. Top of head, sides of head very cavernous, covered with thin naked skin leaving the sharp angles of the bones more or less projecting. A sharp bony crest at occiput ending before and behind in a short spine, the anterior spine the longer and sharper. Between the spines the crest is smooth and concave; in *Collichthys fragilis*, it is nearly always broken up into from 1 to 3 sharp bony tubercles.

Pectoral  $1\frac{2}{3}$  in head; ventral  $1\frac{1}{3}$ , reaching  $\frac{2}{3}$  of distance between its base and vent. Longest dorsal rays 2 in head, equal to those of anal, a little longer than longest spines. Caudal pointed, equal to length of head. The scales on our specimens are all absent, but from the scale pockets, which are evident on the ventral surface, the scales were much larger than in *Collichthys fragilis*. There are 10 scales in a row

between base of ventral and vent. In *Collichthys fragilis* there are 17 or 18 in this region.

Color in spirits, pinkish and yellowish, slightly dusky above, fins without color. On ventral surface there are rows of creamy white spots, each one indicating a scale. A median row of 4 forward from between ventrals to isthmus; a row of 3 each side of this from each ventral forward; 10 or 11 from each ventral back to vent; 21 from front of anal along base of anal and lower part of caudal peduncle to base of lower caudal rays. The rows extending upward on side of belly to a level with lower pectoral rays. In *Collichthys fragilis* there are 8 spots forward from between ventrals in a median line; 6 or 7 on each side of this; 17 or 18 from each ventral to side of vent; 27 or 28 from front of ventral to base of caudal. The vertical distance between the rows is decreased in a corresponding degree.

The above description is from the type, 110 mm. in length. Other specimens vary as follows: Depth 3 to  $3\frac{1}{2}$  in length. Eye  $4\frac{1}{4}$  to  $4\frac{3}{4}$  in head. Dorsal, VIII, 23 to IX, 25; anal, II, 11 or II, 12.

Besides the differences noted above, this species has a larger eye (from 5 to 6 in head in *Collichthys fragilis*) and a shorter soft dorsal (26 or 27 rays in *Collichthys fragilis*). The number of spots on the ventral surface is the most conspicuous character for separating these two species. *Collichthys lucidus* has more dorsal rays than either of these.

About thirty specimens were collected, the largest 150 mm. in length.

*Type*.—Cat. No. 55632, U.S.N.M.; cotypes No. 9884, Stanford University.

#### 15. PSEUDOSCIÆNA MITSUKURII (Jordan and Snyder).

A specimen 34 cm. in length agrees very well with the description of the type and with a specimen of about equal size from Matsushima, Japan.

For the present we place this species in *Pseudosciæna* rather than in *Pseudotolithus*. The relations of both genera to allied forms needs further study.

### Family TRIGLIDÆ.

#### 16. LEPIDOTRIGLA MICROPTERA Günther.

Five specimens taken at Port Arthur. They differ from specimens from Japan in having a wider, flatter interorbital space; the rostral processes more projecting, the distance across them greater, and armed with longer, stronger spines. The Port Arthur specimens, though differing considerably in the extreme from the Japanese specimens, grade into the latter in all of these characters, as is shown in the following table of measurements:



*Measurements in hundredths of length without caudal.*

| Locality.                                                    | Port Arthur. |        |          |        | Matsu-shima. | Aomori. | Hakodate. | Tokyo.   |          |         |
|--------------------------------------------------------------|--------------|--------|----------|--------|--------------|---------|-----------|----------|----------|---------|
| Length in millimeters.....                                   | 240          | 255    | 210      | 191    | 168          | 210     | 197       | 165      | 196      | 168     |
| Head in hundredths of length <i>a</i> .....                  | 31           | 30     | 31       | 32     | 30           | 30      | 29        | 31       | 28       | 31      |
| Depth at occiput.....                                        | 21           | 20     | 20       | 21     | 22           | 22      | 20        | 21       | 20       | 21      |
| Orbit.....                                                   | 8            | 8      | 8        | 8      | 8            | 8       | 8         | 8        | 7½       | 8       |
| Interorbital width.....                                      | 8½           | 9      | 9        | 8½     | 8½           | 8½      | 8         | 8        | 7½       | 8       |
| Least postorbital width.....                                 | 6½           | 6      | 6½       | 7      | 7            | 6½      | 6½        | 6        | 7½       | 8       |
| Length of snout.....                                         | 14           | 13     | 14       | 15     | 14           | 14      | 12½       | 14       | 13       | 13      |
| Width of snout at tip of mandible.....                       | 10½          | 9½     | 10½      | 12     | 10           | 8½      | 8         | 9        | 13       | 9       |
| Projection of rostrum beyond premaxillary.....               | 2            | 2½     | 2½       | 2½     | 2½           | 2       | 1         | 1½       | 1        | 1½      |
| Length humeral spine from inner edge of shoulder girdle..... | 12           | 11     | 14       | 13     | 12           | 13      | 12        | 13       | 12       | 13      |
| Length of upper detached pectoral ray.....                   | 18           | 18     | 18       | 20     | 18           | 20      | 21        | 20       | 18       | 21      |
| Length of second dorsal spine.....                           | .....        | 19     | 20       | 21     | 20           | 19      | 20        | 20       | 18½      | 19      |
| Length of pectoral.....                                      | 28           | 28     | 29       | 31     | 29           | 29      | 31        | 30       | 29       | 31      |
| Number of dorsal rays.....                                   | IX, 17       | IX, 17 | VIII, 17 | IX, 17 | IX, 17       | IX, 17  | IX, 17    | VIII, 17 | VIII, 16 | VIII, 1 |
| Number of anal rays.....                                     | 17           | 17     | 17       | 17     | 16           | 16      | 17        | 16       | 16       | 17      |
| Scales in lateral line.....                                  | 64           | 64     | 63       | 64     | 63           | 63      | 65        | 64       | 63       | 64      |

*a* All measurements taken from tip of rostral process without spines.

17. *CHELIDONICHTHYS KUMU* (Lesson and Garnot).

Two large specimens. We have compared these and numerous specimens from Japan with three specimens from Australia. The rostral processes are usually a little more produced, making the snout notched in front in the northern specimens and the interorbital space slightly less concave. The spots on the inner surface of the pectoral are variable in number and position. On one of the Australian specimens they are scattered over the entire fin; in another they are confined to the lower half of the fin. In our Port Arthur specimens they are scarcely evident. These differences are too slight to consider as specific differences.

## Family HEXAGRAMMIDÆ.

18. *HEXAGRAMMOS OTAKII* Jordan and Starks.

Several small specimens taken.

## Family SCORPÆNIDÆ.

19. *SEBASTODES FUSCESCENS* (Houttuyn).

Several small specimens preserved.

20. *TRACHIDERMIS FASCIATUS* Heckel.

(*Centridermichthys ansatus* RICHARDSON.)

One specimen. It agrees very well in all characters with specimens from Kiusiu in Japan.

It is probable that the Chinese and Japanese species called *ansatus* is the same as the original *fasciatus*. The latter was reported to be from the Philippines but it is not likely that any cottoid fish occurs in these tropical islands.

## Family PLATYCEPHALIDÆ.

21. *PLATYCEPHALUS INSIDIATOR* (Forskål).

Three specimens collected which have been compared with specimens from Japan and found to be identical.

## Family GOBIIDÆ.

*RANULINA* Jordan and Starks, new genus.

Body depressed, with a broad frog-like head; lower jaw projecting; teeth slender, in two rows, the outer series longer and curved outward, fringing the jaws; inner teeth turned backward; scales 40, cycloid. Cheeks, opercles, and nape scaly; lower parts of head with short divided tentacles. Dorsal rays VII-17. Anal rays 17. Caudal moderate, rounded; pectoral broad, rounded.

Allied to *Triænopogon*, but with the teeth very peculiar, unlike those of any other goby known to us.

*Type of genus*.—*Ranulina fimbriidens*.

22. RANULINA FIMBRIIDENS Jordan and Starks, new species.

Head 3 in length to base of caudal; depth  $6\frac{1}{5}$ . Eye  $10\frac{1}{2}$  in head measured obliquely across top of head from union of premaxillaries to tip of opercle; snout 3; maxillary  $1\frac{3}{5}$ ; interorbital space 5. Dorsal VII-17; anal 17; scales 40.

Head very much depressed; its depth about a third of its length; as viewed from above, its outline forms a semicircle from the posterior end of one maxillary to the posterior end of the other. Lower jaw slightly projecting; the maxillary reaching  $1\frac{1}{2}$  diameters of the eye past eye. Teeth rather long, slender and sharp, set in two rows in jaws and rather widely spaced. The teeth of inner row smaller and curved inward, the outer row set on the edge of the jaw and directed obliquely outward, sometimes nearly horizontal, and forming a conspicuous fringe around front of head. Entire lower part of head

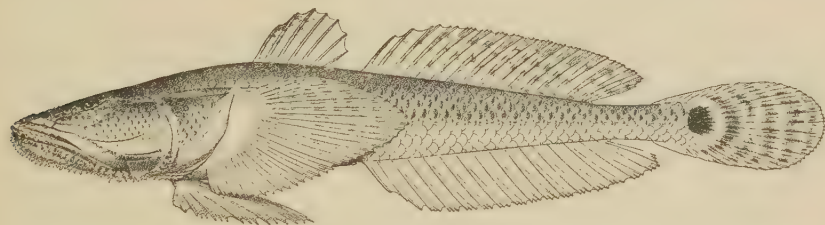


FIG. 3.—RANULINA FIMBRIIDENS.

thickly covered with fine tentacles especially numerous over a large area medially; rows of them follow the edge of mandible and upward on edge of preopercle; some of them on edge of preopercle continued backward on lower part of cheek behind maxillary; a row on each branchiostegal ray. A few short papillæ on upper part of snout. A slight ridge on supraorbital region turning abruptly outward a short distance behind eye; interorbital space shallow, concave.

Scales of moderate size, smooth and rather thin. Cheeks, opercles, and nape scaled.

Pectoral broad and rounded, reaching past front of anal, its base oblique following contour of opercle. Distance from base of last dorsal spine to first dorsal ray a little greater than width of interorbital space. Longest dorsal spines,  $3\frac{1}{5}$  in head, a little shorter than longest soft rays. Ventrals connected, broadly rounded, not adnate to belly. Anal ending slightly posterior to dorsal; caudal rounded, its length equal to that of ventral,  $1\frac{5}{6}$  in head.

Color in spirits: scales broadly outlined with dusky points on posterior margins; top of head dusky and slightly mottled; lower parts

colorless; faint dusky lines obliquely across dorsal rays; broader and fainter ones cross pectoral rays; ventrals and anal colorless. A conspicuous dark spot at base of caudal behind which are three lunate dark bands across caudal rays.

Many specimens were obtained.

*Type*.—Cat. No. 55633, U.S.N.M., is 110 mm. in length; cotypes are No. 9882, Stanford University.

23. *TRIDENTIGER BIFASCIATUS* Steindachner.

A single specimen agreeing very well with specimens from Japan.

24. *TÆNIOIDES ABBOTTI* Jordan and Starks, new species.

Head  $5\frac{1}{2}$  in length to base of caudal; depth 2 in head; maxillary  $2\frac{1}{2}$ ; interorbital space  $5\frac{1}{2}$ . Dorsal, VI, 47; anal 44.

Mouth very oblique, forming an angle of about 45 degrees. Lower jaw bluntly rounded, no bony knob at symphysis, or no barbels present. Small sharp teeth in a single row in jaws, outside of which are 2 or 3 long sharp canines on each side, which shut outside of the jaws. Eyes reduced, appearing as small inconspicuous dark dots.

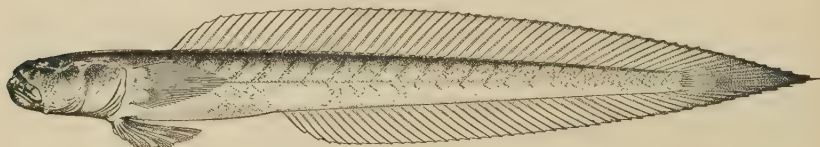


FIG. 4.—*TÆNIOIDES ABBOTTI*.

No scales apparent. Pectorals long and pointed, nine-tenths of length of head in the type, a little longer than head in the cotype; their tips reach a considerable distance past tips of ventrals. Ventrals adnate to belly at anterior third of their length; they are inserted somewhat anterior to base of pectorals and their length is contained  $1\frac{1}{4}$  times in head. Origin of dorsal at the beginning of the anterior fourth of the length of body from base of caudal to tip of snout. Dorsal not enveloped in thick skin, the spines not differentiated from soft rays. Caudal long and pointed, continuous with dorsal and anal.

Color in spirits flesh color, purplish on head, slightly dusky on back; top of head and front part of mandible dusky; fins colorless.

Two specimens taken, the largest 90 mm. in length.

*Type*.—Cat. No. 55634, U.S.N.M.; cotypes No. 9881, Stanford University.

This species differs from all others of its genus in having much longer pectorals and in having more fin rays than any other species without barbels on the mandible.



## Family PLEURONECTIDÆ.

25. *VERASPER VARIEGATUS* (Schlegel.)

Several small specimens and one adult.

26. *PROTOPSETTA HERTZENSTEINI* (Schmidt).

Two specimens obtained.

Head,  $3\frac{2}{3}$  in length to base of caudal; depth  $2\frac{1}{2}$ . Eye,  $5\frac{1}{2}$  in head; snout,  $4\frac{1}{3}$ ; maxillary  $2\frac{4}{5}$ ; interorbital space, 13. Dorsal, 73; anal, 57; scales, 78.

Lower jaw strongly projecting and with a moderately strong symphyseal knob. Teeth small and sharp, in a single series on the front of the latter. Maxillary extending to opposite end of anterior third of lower eye. Upper eye with its range nearly vertical and slightly posterior to lower eye. Interorbital space convex, its width equal to half vertical diameter of upper eye; it extends backward as a conspicuous, rough, but not sharp ridge. Gillrakers slender, 15 of them on lower limb of first arch, the longest ones equal to half the long diameter of lower eye.

Scales cycloid with ctenoid scales in more or less definite areas. The latter, in addition to spinules on their posterior edges, are thickly covered over the surface with small sharp spinules, making them very rough to the touch. These are particularly rough on head, especially on ridge running back from interorbital space. An area of them along middle of side, the area becoming broader and the scales more typically ctenoid posteriorly. A single row of rough scales along base of dorsal and anal, and the anterior rays of dorsal and anal each with a single row of similar scales. Tip of snout, mandible, and all but posterior part of maxillary naked. Scales of blind side everywhere cycloid.

Dorsal anteriorly turning a little toward the blind side, the first ray at extreme edge of eye. Pectorals rounded, but not bluntly, that of eyed side  $2\frac{1}{10}$  in head; its fellow  $2\frac{3}{5}$ . Caudal with the middle rays slightly the longest. A strong spine on pelvis girdle just behind base of ventral fins pointing downward and backward; anal spine moderately developed.

Color uniform brown, slightly darker toward edges of fins. Lateral line darker than surrounding body color.

Here described from a specimen 32 cm. in length.

27. *LIMANDA YOKOHAMÆ* (Günther).

Several small specimens.

28. *KAREIUS BICOLORATUS* (Basilewsky).

One small specimen.

29. *PARALICHTHYS OLIVACEUS* (Schlegel).

Two small specimens.

## Family SOLEIDÆ.

30. *ARELISCUS RHOMALEUS* Jordan and Starks, new species.

Head,  $4\frac{1}{3}$  in length to base of caudal; depth, 4. Eye, 19 in head, 7 in snout; snout,  $2\frac{3}{4}$ . Dorsal, 124; anal, 96; scales, 148 from vertically opposite upper end of gill opening; 17 anterior to this point and transverse row of pores.

Interorbital space wide, flat, and scaled; its width  $1\frac{1}{2}$  times diameter of upper eye. Upper eye from one-fourth to one-half of its diameter in advance of lower. Hook of upper jaw moderate, not nearly reaching to opposite front of eyes. Maxillary extending half a diameter of eye past posterior margin of lower eye. Nostrils as usual, the upper one between front of eyes, the lower one in a tube at edge of mouth.

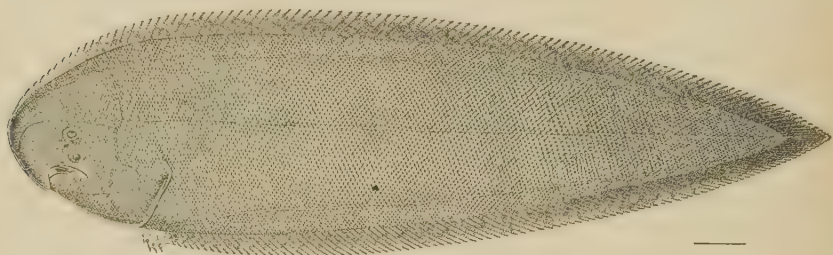


FIG. 5.—*ARELISCUS RHOMALEUS*.

Scales strongly ctenoid on eyed side of head and body, cycloid on reverse side. The three lateral lines on body and the connecting branches on head very conspicuous. At middle of body the lines are separated by 24 rows of scales counting obliquely. No lateral line on blind side of body; a light line suggests one, but no pores are present.

Body and fins uniform dark brown on eyed side, no color on fins on blind side.

This species is close to *Areliscus abbreviatus* (Gray), but the scales are finer. The latter, according to Günther, has 120 scales in a lateral series and the lateral lines are separated by 19 series of scales. *Areliscus trigrammus* (Günther) has a longer dorsal, larger eyes, and narrower interorbital space.

Here described from the type, 38 cm. in length, Cat. No. 55635, U.S.N.M. Several cotypes are numbered 9883, Stanford University.

## Family GADIDÆ.

31. *GADUS MACROCEPHALUS* Tilesius.

One specimen.

## NOTES ON THE SLOW LEMURS.

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### INTRODUCTION.

The following notes are not intended as a critical revision of the Slow Lemurs, and the conclusions here arrived at can not be considered as final, but in studying the specimens of the genus *Nycticebus*<sup>a</sup> in the collection of the United States National Museum some interesting facts have been brought to light which seem worth recording.

For a consideration of the generic and specific names for the Slow Lemurs, the reader is referred to the Revision of the Genus *Nycticebus*, by Stone and Rehn.<sup>b</sup> All of the forms there recognized are here considered as valid and two others are described. Messrs. Stone and Rehn had but eight specimens at their disposal, but now, due to the activities of Dr. W. L. Abbott in the Malayan region, I have before me 23 specimens, 8 of which are all from one locality in western Borneo. Even this seemingly abundant material is altogether too scant for arriving at definite conclusions. Here I wish to express my obligations to Mr. Witmer Stone of the Philadelphia Academy of Natural Sciences for the use of two specimens from Sumatra and one from Java.

Most writers have placed considerable weight on color as a specific character, often from lack of material overlooking the wide range of variation in specimens from a given locality. The only attention

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<sup>a</sup> Dr. Ménegaux, of the Paris Museum, in a letter to Mr. Gerrit S. Miller, jr., dated June 6, 1906, writes: "I have looked up that which you asked me concerning *Bradicebus*. The word is not cited in *Magasin encyclop.* 1795, *classification des Mammifères* by Geoffroy and Cuvier (in vol. II), although Gervais, apropos of the article on mammals, in the *Dict. Pittoresque d'Hist. Nat. et de phénom. de la nature*, vol. IV, p. 617, says textually 'Geoffroy and Cuvier published together in vol. VI (?) of the *Magasin encyclopédique* a classification of mammals, which we transcribe entire: . . . Cucang, *Bradicebus*; Khoyak, *Chirosciurus*; Tarsier, *Macrotarsus*.' . . . The citation of Gervais is given incorrectly." Translation.

<sup>b</sup> Proc. Acad. Nat. Sci. Phila., 1902, pp. 136-141.

paid to cranial characters seems to have been confined to the number of upper incisors. Before proceeding to a description of the species in the genus, it will be well to consider some characters of the Slow Lemurs as a whole.

#### PELAGE AND COLOR.

Two different types of hairs are found on the Slow Lemurs: (1) A very dense woolly crinkly coat, corresponding in general to what is known as the underfur in mammals, about 20 mm. in length, on middle of back; and (2), a set of longer hairs, much more scant than the dense woolly ones and from 5 to 10 mm. longer, being nearly straight throughout their length, slight crinkling taking place for a distance of 5 to 10 mm. along the middle. The woolly hairs are not found typically on the face, or on the hands and feet. These two sorts of hairs are not sharply defined types and many individual hairs are seen which are intermediate between the two.

The basal half or a little more of the woolly hairs is of a general slate-gray or almost plumbeous color, darker on the hairs of the back and lighter on those of the belly. Normally, this slaty color is never seen in the upper parts except on parting the thick coat, but on the underparts where the hairy covering is less dense a certain amount of the slaty or plumbeous color shows through. The distal half of the woolly hairs is about equally divided between two colors, a grayish or yellow-gray color next the slaty basal color, and terminally some sort of an ochraceous or buffy color, to which the general color of the animal is due. On the dark face marks when present and along the dorsal stripe the terminal color of the hairs is much darker, varying from a light, bright russet to a very dark brown.

The long straight hairs have little to do with the real general color effect. They seem to be very similar in color to the woolly hairs except at the tip, where there is a large white subterminal ring about 3 to 5 mm. wide. The apical ring is about 1 to 2 mm. wide and dark in color, which is not seen ordinarily and has no effect on the general color. The subterminal white ring, however, often apparently enters very largely into the general color scheme, and in case the hairs are long and their tips not worn produces a conspicuous frosting overlying the general ochraceous color of the upper parts. This frosted effect is most conspicuous in two specimens of *Nycticebus malaianus*, a two-thirds grown individual, Cat. No. 84390, U.S.N.M., from Trong, Lower Siam; and a young adult male, Cat. No. 114151, U.S.N.M., from Johore Lama. In an adult of unknown sex, Cat. No. 84389, U.S.N.M., from Trong, no frosting at all is present except a very slight amount on the upper part of the neck. Except for a few hairs on either side of the dark median stripe no frosting is seen in Cat. No. 142233, U.S.N.M., a young adult male from western Borneo. An adult male, Cat. No. 142234, U.S.N.M., also from western Borneo, shows nearly



as much frosting as Cat. No. 114151, U.S.N.M., from Johore Lama. Between the two extremes all intermediate conditions occur. It should be noted that the extremes are found in specimens from the same locality and in the case of Bornean specimens taken at the same time of year, one July 22 and the other August 15. The frosting is also independent of age.

The difference in general coloration in the series of skins from Borneo is very striking and presents two extremes or phases, between which there are all gradations. The apical color of the woolly hairs in the dullest, Cat. No. 142237 U.S.N.M., a very old adult male, is a little lighter than Ridgway's wood brown, while the brightest colored one, Cat. No. 142233 U.S.N.M., an adult male, is a color intermediate between Ridgway's ochraceous and tawny-ochraceous. It is probable that the same variation would be found in series from other localities were they available. The four skins from the Malay Peninsula show considerable difference in color, but not such extremes as in the case of the Bornean examples.

The dorsal stripe varies considerably in extent and color. In the Bornean series it runs from a rich dark brown similar to Ridgway's seal brown to a color intermediate between his chestnut and russet. In those specimens where it is darkest it is the best defined, while in the others its borders are not so sharp. The width of the stripe varies considerably. In some specimens it extends the whole length of the back, narrowest posteriorly, in others it gradually dies out along the lumbar region.

The head and face markings seem quite uniform in pattern, variations in shape and size apparently depend upon the manner of making up that part of the skin. The markings are produced by a double bifurcation of the dorsal stripe on the top of the head, the posterior pair of bifurcations extending to the ears and diffusing over the cheeks, the anterior pair to the eyes forming a complete circle around them. At the point of the double bifurcation a more or less distinct crown patch is seen. The color of these face-markings is in general concolor with that of the dorsal stripe, but the ring immediately around the eye is darker. In *Nycticebus cinereus* the face and head markings are apparently absent and they are nearly so in *N. coucang*.

#### SKULL AND TEETH.

Depending on the arrangement of the temporal ridges, the skulls of the Slow Lemurs fall into two groups, (1) those in which the ridges eventually meet in the middle line in old age forming a sagittal crest (see Plate XIII, figs. 5-8); and (2) those in which the temporal ridges do not meet in the middle line even in old age, but form two heavy lines parallel with each other, or nearly so, for a considerable distance on the top of the skull. (See Plate XIII, figs. 1-4.) This latter condition I have

seen only in the specimens from Borneo and Banka. The only available skull of a *Nycticebus* from Java is young, and it can not be positively stated whether the temporal ridges would meet in the middle line or whether they would develop heavy parallel ridges as in the Bornean form. The ridges on it, however, look more as they do in young of the species where a sagittal crest is formed than they resemble those in young Bornean examples. Plate XIII shows the progressive development of the two styles of temporal ridges.

There is a progressive increase in size of the skulls with increasing age, which is shown in both the Bornean and Malay Peninsula series. A full set of teeth is no criterion that an animal is fully adult, and only in very old age do the teeth show much wear. In comparing any two species, it is necessary to select individuals of the same age. (See table of measurements, p. 537, and Plate XIII.)

As noted by most writers, the number of upper incisors in the Slow Lemurs varies between two and four, the usual view being that the smaller outer pair are dropped in old age. An examination of the present material shows that the Bornean Slow Lemur never has but two upper incisors. Examination of a very young skull, Cat. No. 142240 U.S.N.M., probably a newborn individual, shows only two upper incisors and no possible place for the small lateral pair of incisors. A very young Sumatran skull, Cat. No. 141142 U.S.N.M., has four upper incisors, two adult Sumatran skulls have four, one adult two, and one adult three. A young Malayan skull, Cat. No. 84390 U.S.N.M., has three; all the other mainland skulls and the one from the Natunas show four upper incisors. In Anderson's Catalogue of Mammalia in the Indian Museum<sup>a</sup> it appears that the number of upper incisors is variable in the mainland species. In the Javan skull the premaxillæ are wanting and nothing can be told about the upper incisors. Anderson<sup>b</sup> and Milne-Edwards<sup>c</sup> state in Javan skulls the number may be either two, three, or four. It looks as if the Bornean form and possibly the one from Banka possess only two upper incisors, while in all the other forms four upper incisors are found, always in the young and often in the adults. If more material should show that this is the case and that it is correlated with the ununited temporal ridges, the Bornean and Bancan *Nycticebi* would form a distinct subgenus. For a tabulation of the number of upper incisors see table of measurements, page 537.

#### DESCRIPTION OF THE SPECIES OF SLOW LEMURS.

In the following account of the species I have made use of binomial names only as there does not appear to be sufficient material to work out intergradation satisfactorily. In general it may be stated that the

<sup>a</sup>Part I, pp. 95-97.

<sup>b</sup>Anderson, Western Yunnan Expedition, Zool. Results, 1879, p. 105.

<sup>c</sup>Milne-Edwards, Nouv. Archiv. du Museum, Bull., III, pp. 10, 11.

species included under A in the following key are closely related, and the same is true of those under C and C'.

Nachtrieb's name *menagensis*<sup>a</sup> for a Philippine Lemur, which he did not place in any genus, I have not considered, being unable to obtain further information regarding it than is given in the original description,<sup>b</sup> which is insufficient to determine its generic place, although it probably belongs to this genus or an allied one.

KEY TO THE SPECIES OF NYCTICEBUS.

- A. Temporal ridges not meeting or approximating each other in old age, but forming two parallel ridges on top of skull; no specimens, not even newborn young, show more than one incisor on each side of upper jaw.
  - B. Mastoid and audital bullæ not inflated; half ring of bone forming outer and lower border of orbit, broad and heavy. Underparts whitish. Borneo.  
*borneanus.*
  - B'. Mastoid and audital bullæ moderately inflated; half ring of bone forming outer and lower border of orbit, narrow and light. Underparts ochraceous buffy. Banka ..... *bancanus.*
- A'. Temporal ridges meeting or approximating each other in old age, eventually forming a sagittal crest on top of skull; most adults show two incisors on each side of upper jaw, and young always do.
  - C. Lines from crown of head to eyes and ears only faintly marked or obsolete. Larger, greatest length of skull less than 63 mm.
    - D. Lines from crown of head to eyes and ears practically obsolete; general color of head, neck, and anterior part of body clear gray. Siam and Cochin China ..... *cinereus.*
    - D'. Lines from crown of head to eyes and ears present but indistinct; general color of head, neck, and anterior part of body not clear gray, merely lighter than general color of upper parts. Eastern Bengal and Burma.  
*coucang.*
  - C'. Lines from crown of head to eyes and ears well marked and conspicuous. Smaller, greatest length of skull about 58 mm.
    - E. Dorsal stripe bordered on either side, in neck and upper back, by a distinct gray area. Java ..... *javanicus.*
    - E'. Dorsal stripe not bordered on either side in neck and upper back by a distinct gray area.
      - F. General color of upper parts intense and rich; hands, feet, and ears dusky. Natuna islands ..... *natunæ.*
      - F'. General color of upper parts not so intense or rich; hands, feet, and ears not dusky.

<sup>a</sup> In a letter under date of June 7, 1906, Professor Nachtrieb writes: "I can not find out whether that specimen of *menagensis* ever reached Minneapolis or not . . . the account of the 'New Lemur' was not my account . . . Mr. Worcester, I think, was the author of the account printed . . . the idea of giving a specific name before having determined the generic name struck me as rather odd . . . lost boxes . . . possibly this lemur was in that lot."

According to the A. O. U. Code the Philippine Slow Lemur (if there is one) can not be considered as having a scientific name. See Canon XXXVIII, where a similar case is cited.

<sup>b</sup> Zool. Anzeiger, XV, 1892, p. 147.

- G. Size slightly smaller; greatest length of skull about 58 mm.; mastoid and audital bullæ smooth, rounded, and rather inflated. Malay Peninsula, and lowlands of Sumatra ..... *malaianus*.  
 G'. Size slightly larger; greatest length of skull about 61 mm.; mastoid and audital bullæ irregularly grooved, not inflated. 1,500-3,000 feet in Sumatra ..... *hilleri*.

#### NYCTICEBUS COUCANG (Boddaert.)

1783. *Tardigradus coucang* BODDAERT, Elenchus-animalium, p. 67 (Fide Stone and Rehn).

1812. *Nycticebus bengalensis* E. GEOFFROY, Ann. du Mus., XIX, p. 164.

*Distribution*.—The type locality is given by Stone and Rehn as Bengal. It probably ranges throughout Burma and eastern Bengal.<sup>a</sup>

*Diagnostic characters*.—Size large, greatest length of skull about 63 mm.; temporal ridges forming a sagittal crest in old age; upper incisors usually two on each side; face markings indistinct; face, neck, and forearms not conspicuously gray.

*Color*.—General color of upper parts of the single specimen at hand similar to Ridgway's buff, becoming dirty grayish about the head, neck, and underparts. Four face lines present but indistinct; dorsal stripe extending whole length of back, narrow, 5 to 10 mm. wide, generally similar to Ridgway's cinnamon.

*Skull and teeth*.—Skull large, temporal ridges meeting in age to form a sagittal crest. Upper incisors usually two on each side.

*Measurements*.—See table, page 537.

*Specimens examined*.—A mounted skin, Cat. No. 14290, U.S.N.M., and its skull, Cat. No. 21179, U.S.N.M., received by the U. S. National Museum in the flesh from Central Park, New York City, in April, 1884.

*Remarks*.—While no locality is known for the above specimen, yet it seems to agree in size and color with the specimens referred to by Blanford<sup>b</sup> as the large northern variety. It is distinctly different from Edwards's<sup>c</sup> plate of *cinereus*, and from any other specimens in the National Museum. It is generally lighter in color than Audebert's<sup>d</sup> plate.

#### NYCTICEBUS CINEREUS Milne-Edwards.

1867. *Nycticebus cinereus* MILNE-EDWARDS, Nouv. Archiv. du Mus., Bull., III, p. 11, pl. III.

*Distribution*.—Vicinity of Bangkok should probably be regarded as the type locality. Its range is given by Edwards as Siam and Cochin China.

*Diagnostic characters*.—Similar to *Nycticebus coucang*, but head, neck, and forearms clear gray and face markings obsolete.

<sup>a</sup> Blanford, Fauna British India, Mammalia, 1888, p. 46; and Anderson, Zool. Results Two Expeditions Western Yunnan, 1879, p. 101.

<sup>b</sup> Blanford, Fauna British India, Mammalia, 1888, p. 46.

<sup>c</sup> Milne-Edwards, Nouv. Archiv. Mus., Bull., III, pl. III.

<sup>d</sup> Audebert, Hist. Nat. des Singes et des Makis, 1800, pl. I.



*Skull and teeth.*—Skull large, temporal ridges of the type forming a sagittal crest, although in the figure they have not yet met. Upper incisors two on a side.

*Measurements.*—See table, page 537.

*Specimens examined.*—None.

*Remarks.*—This species is usually regarded as the same as *Nycticebus senegalensis*, but the descriptions and figures of the two certainly make them appear distinct. Not much can be determined until good series from the type localities are examined.

#### NYCTICEBUS MALAIANUS (Anderson).

1881. *Nycticebus malaiensis* JAR. ~~malaiensis~~ ANDERSON, Catalogue Mammals Indian Museum, I, p. 95.

*Distribution.*—Malay Peninsula and the coast regions of Sumatra.

*Diagnostic characters.*—Size small, face markings prominent, temporal ridges forming a crest in old age, audital and mastoid bullae moderately inflated, upper incisors usually two on a side.

*Color.*—General color of the upper parts ranges in different specimens from wood brown to a dark ochraceous buff; more or less frosting is caused by the subterminal white band of the long hairs. The dorsal stripe usually widest over the shoulders may extend the whole length of the back or gradually disappear in the lumbar region. In color it varies from a rich, deep brown similar to seal brown to a dark tawny. Face markings are conspicuous and concolor generally with the dorsal stripe. Underparts dirty pinkish or cream buff, the silty bases of the hairs showing through.

*Skull and teeth.*—Temporal ridges meet to form a sagittal crest in old age. Upper incisors four in the young and usually in the adult, though they may be reduced to three or two; audital and mastoid bullae smooth, rounded, and moderately inflated.

*Measurements.*—See table, page 537.

*Specimens examined.*—Seven skins with skulls, five from the Malay Peninsula and two from the west coast of Sumatra, and one alcoholic from west coast of Sumatra.

*Remarks.*—One specimen, Cat. No. 84382, U.S.N.M., from Trong, Lower Siam, has a skull differing considerably from the others of the series. Its brain case is much depressed and the outer and upper walls of the orbit stand out and up from the rest of the skull much more than they do in the other specimens. The two Sumatran specimens, one from Tapanuli Bay and the other from Tarusan Bay, I am unable to associate with *Nycticebus hilleri* Stone and Rehn, which is a slightly larger animal and has less inflated and more furrowed bullae.

## NYCTICEBUS HILLERI (Stone and Rehn.)

1902. *Nycticebus coucang hilleri* STONE and REHN, Proc. Acad. Nat. Sci. Phila., March, 1902, issued June 4, 1902, p. 139.

*Distribution.*—Probably the mountainous regions of Sumatra, known only from the type locality, Batu Sangkar, Tanah Datar, Padangsche Bovenland, Sumatra.

*Diagnostic characters.*—Similar to *Nycticebus malaianus*, but slightly larger, with audital and mastoid bullae not smooth, rounded and inflated, but irregularly grooved instead.

*Color.*—Of the two specimens examined one has a general wood-brown effect above with considerable frosting, and the other a very dull ochraceous. Dorsal stripe extends whole length of back but indistinct posteriorly, dark brown in color. Head markings dull russet, considerably obscured by grayish tips to hair. Underparts dirty buffy, slaty bases of hairs showing through.

*Skull and teeth.*—Skull nearly as large as that of *Nycticebus coucang*. Temporal ridges forming a crest in old age. Upper incisors, four in the young, two in adults. Mastoid and audital bullae irregularly wrinkled.

*Measurements.*—See table, page 537.

*Specimens examined.*—Two, the type and a paratype.

*Remarks.*—This species appears to be a larger mountainous form of *Nycticebus malaianus*, from which it seems to differ but slightly.

## NYCTICEBUS NATUNÆ (Stone and Rehn).

1902. *Nycticebus coucang natunæ* STONE and REHN, Proc. Acad. Nat. Sci., Phila., March, 1902, issued June 4, 1902, p. 140.

*Distribution.*—Island of Bunguran, North Natuna Islands.

*Diagnostic characters.*—Similar to *Nycticebus malaianus*, but darker in color and with dusky hands, feet, and ears.

*Color.*—Upper parts generally similar to Ridgway's russet, a slight amount of frosting. Dorsal stripe extending entire length of back, but indistinct on rump, broadest over shoulders, dark brown, almost blackish in places; on crown of head and face markings, like Ridgway's burnt umber, but lighter; rings about eyes almost black. Underparts generally dark ochraceous buff except on throat which is grayish. Upper surfaces of hands and feet irregularly blotched with blackish, ears with brownish black.

*Skull and teeth.*—The skull of *Nycticebus natunæ* does not differ appreciably from skulls of *N. malaianus*. The interorbital constriction is not so pronounced and the mastoid bullae are a little less inflated. Four incisors are present in the upper jaw.

*Measurements.*—See table, page 537.

*Specimens examined.*—One, the type, Cat. No. 104599, U.S.N.M.

*Remarks.*—This species appears as a slightly differentiated form of

*Nycticebus malainus*. While it is darker above and below than the average of the peninsular animals, yet this is probably within the limits of individual variation. The black blotching on the hands and feet is so irregular that it may be abnormal, a couple of blackish spots are also found on the forearms. The brownish coloring about the ears looks more normal.

**NYCTICEBUS JAVANICUS E. Geoffroy.**

1812. *Nycticebus javanicus* E. GEOFFROY, Ann. du Museum, XIX, p. 164.

*Distribution*.—Java.

*Diagnostic characters*.—A small light-colored species, with well-defined dorsal and face stripes, the dorsal stripe bordered by a distinct grayish area along neck and upper back.

*Color*.—Sides of body and lower back dirty-pinkish buff; underparts similar, but lighter; head, neck, and upper back dirty grayish; dorsal stripe well marked, most pronounced in middle of back, gradually disappearing on the rump, blackish brown along the middle, dull cinnamon posteriorly, darker cinnamon on the head; face markings a mixture of cinnamon and Isabella color, becoming light russet about the ears.

*Skull and teeth*.—The single skull is young and lacks the premaxillæ. Temporal ridges appear to belong to the type that meet in old age to form a sagittal crest. Mastoid and audital bullæ not inflated. According to Anderson and Milne-Edwards the number of upper incisors may be two, three, or four.

*Measurements*.—See table, page 537.

*Specimens examined*.—One, Cat. No. 6475, Acad. Nat. Sci. Phila. The specimen is labeled as having come from the Philadelphia Zoological Society, which throws some doubt on its really having come from Java.

*Remarks*.—The grayish color bordering the dark markings makes this species appear quite distinct in color from other island forms. With the exception of the well-defined face markings, the anterior part of the animal resembles quite closely Edward's figure of *Nycticebus cinereus*. Many authors have laid stress on the distinctness of the head markings in the Javan animal, but they are not more distinct than in many examples of other species except *N. coucang* and *N. cinereus*.

**NYCTICEBUS BORNEANUS, new species.**

*Type*.—Adult male, skin and skull, Cat. No. 142234, U.S.N.M., collected along the Sakaian River, a tributary of the Kapuas River, Sanggau district, western Borneo, August 15, 1905, by Dr. W. L. Abbott. Original number 4322.

*Distribution*.—Western Borneo.

*Diagnostic characters*.—Temporal ridges never meeting to form a

sagittal crest; upper incisors, only two; outer and lower wall of orbit wide, about 7 mm.; bullæ not swollen, underparts grayish white.

*Color*.—Upper parts range from a light wood brown to a color between ochraceous and tawny ochraceous (type is of latter color, moderately frosted). Dorsal stripe and face marks range from a light, bright russet to a dark brown, similar to a dark burnt umber (latter color in the type). Dorsal stripe is widest in region of shoulder and gradually disappears on the rump or on lower back (as in the type). Underparts light grayish, irregularly spotted in two specimens (one the type), with a pinkish buff. Individuals may or may not be frosted, type moderately frosted.

*Skull and teeth*.—Temporal ridges never uniting to form a sagittal crest, forming instead two parallel ridges on top of skull. Never more than two upper incisors even in the very young; lower outer wall of orbit about 7 mm. wide, bullæ not swollen.

*Measurements*.—See table, page 537.

*Specimens examined*.—Seven skins with skulls and two alcoholics from western Borneo.

*Remarks*.—*Nycticebus borneanus* is very distinct and needs no comparison with any of the preceding species.

#### NYCTICEBUS BANCANUS, new species.

*Type*.—Adult female. Skin and skull, Cat. No. 124907, U.S.N.M., collected at Klabat Bay, Island of Banka, east of Sumatra, June 24, 1904, by Dr. W. L. Abbott. Original number 3432.

*Distribution*.—Island of Banka.

*Diagnostic characters*.—Like *Nycticebus borneanus*, but underparts darker, bullæ more inflated and lower outer rim of orbit narrow, about 3 mm. wide.

*Color*.—*Type*: Upper parts generally a color something between Ridgway's ochraceous-buff and ochraceous with practically no frosting; dorsal stripe something between a dark russet and tawny. Dorsal stripe not of the well-defined type, disappearing in the lumbar region. Face markings concolor with dorsal stripe. Underparts a mixture of grayish and ochraceous-buff.

*Skull and teeth*.—Skull similar to that of *Nycticebus borneanus*, but the mastoid bullæ are slightly more inflated and the outer and lower walls of the orbit are narrow, about 3 to 4 mm. wide, against 6 to 8 in *N. borneanus*. Upper incisors only two.

*Measurements*.—See table, page 537.

*Specimens examined*.—One, the type.

*Remarks*.—*Nycticebus bancanus* is apparently a well-marked offshoot of *N. borneanus*. The skin of the type and only specimen is practically indistinguishable from Cat. No. 142233, U.S.N.M., one of the paratypes of *N. borneanus*, but the narrowness of the outer and lower orbital wall in *N. borneanus* at once distinguishes the two species.



Measurements of the species of *Nycticebus*.

| Species.                   | Cat. No.       | Locality.                                        | Sex.   | Age.           | Number of upper incisors. | Head and body. | Tail. | Hind foot. | Greatest length of skull. | Basal length. | Greatest width of skull. | Width of brain case above zygomata. | Front of canine to back of last upper molar. | Mandible condyle to front of symphysis. |
|----------------------------|----------------|--------------------------------------------------|--------|----------------|---------------------------|----------------|-------|------------|---------------------------|---------------|--------------------------|-------------------------------------|----------------------------------------------|-----------------------------------------|
| <i>N. coucang</i> .....    | 14200<br>21179 | { Unknown.....                                   | Male   | Adult          | 4                         | a 380          | ..... | a 65       | 63.5                      | 56.2          | 44.6                     | 33.8                                | 22.8                                         | 41                                      |
| <i>N. cinereus</i> .....   | 84390          | Near Bangkok                                     | .....  | do             | 4                         | .....          | ..... | .....      | e 63                      | e 55          | e 45.5                   | e 35                                | e 23.5                                       | e 42                                    |
| <i>N. malayanus</i> .....  | 114151         | Lower Siam: Trong                                | Male   | Young          | 3                         | a 220          | ..... | a 50       | 50                        | 40.8          | 30.2                     | 27.9                                | 15.5                                         | 29.6                                    |
| Do.....                    | 8389           | Malay Peninsula: Johore Lama                     | Male   | Nearly adult   | 4                         | 280            | 10    | 60         | 56.4                      | 46.5          | 37.5                     | 31.4                                | 19.8                                         | 35                                      |
| Do.....                    | 115496         | Lower Siam: Trong                                | Female | Adult          | 4                         | 300            | 10    | 63         | 59.2                      | 51.6          | 40                       | 30.8                                | 21.4                                         | 37.9                                    |
| Do.....                    | 105022         | Pahang: Rumpin River                             | .....  | do             | 4                         | 300            | 10    | a 62       | 58.6                      | 48.7          | 41.3                     | 31.8                                | 21                                           | 36.6                                    |
| Do.....                    | e 141142       | Malay Peninsula: Tringannu                       | do     | Old adult      | 4                         | 305            | 13    | a 61       | 59.6                      | 51.5          | 41.1                     | 30                                  | 21.5                                         | 38.8                                    |
| Do.....                    | 141141         | Western Sumatra: Tarusan Bay                     | Male   | Very young     | 4                         | 205            | 8     | 40         | 43.2                      | 34.8          | 26.4                     | 26.2                                | 24.5                                         | 24.5                                    |
| Do.....                    | 114160         | do                                               | Female | Adult          | 4                         | 300            | 17    | 64         | 57                        | 48.2          | 39.5                     | 31.4                                | 20.8                                         | 36.5                                    |
| Do.....                    | 11460          | Western Sumatra: Tapanuli Bay                    | Male   | Old adult      | 4                         | 312            | 16    | a 61       | 59                        | 51.1          | 44.4                     | 32.4                                | 20.6                                         | 37.5                                    |
| <i>N. hilleri</i> .....    | f, a 6590      | Sumatra: Padang, 1,500-3,000 feet                | do     | Adult          | 2                         | a 330          | ..... | a 62       | 61.9                      | 51.8          | 45.2                     | 32.3                                | 21.8                                         | 39.8                                    |
| Do.....                    | a 104599       | do                                               | Female | Nearly adult   | 3                         | a 280          | ..... | a 52       | 56.2                      | 46            | 36.8                     | 29                                  | 20.3                                         | 35.6                                    |
| <i>N. natunae</i> .....    | f 6475         | Bunguran, Natuna Islands                         | Male   | Young adult    | 4                         | 305            | 13    | 64         | 58.9                      | 49.3          | 40.5                     | 31.2                                | 21.2                                         | 37.3                                    |
| <i>N. javanensis</i> ..... | e 142240       | Java.....                                        | do     | do             | 2                         | a 280          | 5     | a 55       | b 57                      | 25.5          | 37.8                     | 31.3                                | 20.3                                         | 35.5                                    |
| <i>N. borneensis</i> ..... | e 142235       | Western Borneo: Sanggau                          | do     | Very young     | 2                         | 140            | 6     | 27         | .....                     | .....         | .....                    | .....                               | .....                                        | 19                                      |
| Do.....                    | .....          | Western Borneo: Kapuas River at mouth of Sakalam | do     | Nearly adult   | 2                         | 300            | 10    | 58         | .....                     | 44.6          | 35.3                     | 30                                  | 19.6                                         | 32.6                                    |
| Do.....                    | 142238         | Western Borneo: Sanggau                          | Female | Adult          | 2                         | 273            | 13    | 60         | 53.7                      | 45.6          | 37.5                     | 30.5                                | 19.6                                         | 33.2                                    |
| Do.....                    | 142239         | do                                               | do     | do             | 2                         | 268            | 14    | 62         | 53.8                      | 44.4          | 36.6                     | 30.2                                | 19.2                                         | 33.4                                    |
| Do.....                    | 142232         | Western Borneo: Landak River                     | Male   | Old adult      | 2                         | 277            | 18    | 64         | 56.1                      | 46.7          | 37.4                     | 30                                  | 20.5                                         | 35.7                                    |
| Do.....                    | 142233         | Western Borneo: Kapuas River, Tyan               | do     | do             | 2                         | 265            | 15    | 66         | 54.3                      | 45.3          | 39.4                     | 29.3                                | 19.5                                         | 32.9                                    |
| Do.....                    | 142236         | Western Borneo: Sanggau                          | do     | do             | 2                         | 284            | 11    | 66         | 53.7                      | 46            | 38.7                     | 29.5                                | 19.7                                         | 34                                      |
| Do.....                    | a 142234       | Western Borneo: Sakalam River, Sanggau district  | do     | Very old adult | 2                         | 293            | 12    | 67         | 53.6                      | 46.8          | 42.1                     | 30.3                                | 19.4                                         | 37                                      |
| Do.....                    | 142237         | Western Borneo: Sanggau                          | do     | do             | 2                         | 299            | 13    | 64         | 58.4                      | 48.9          | 40.4                     | 32.3                                | 20.7                                         | 36.9                                    |
| <i>N. bancanus</i> .....   | a 124907       | Banka: Klabat Bay                                | Female | Adult          | 2                         | 927            | 8     | 62         | 56.2                      | 46.4          | 37.8                     | 30                                  | 19.1                                         | 34.6                                    |

a Measurements taken from the skin.

b Estimated.

c Measured from the figures of skull on plate III, Nouv. Archiv. du Museum, Bull. III.

a Type.

e In alcohol.

f Coll. Philadelphia Academy of Natural Sciences.

## EXPLANATION OF PLATE XIII.

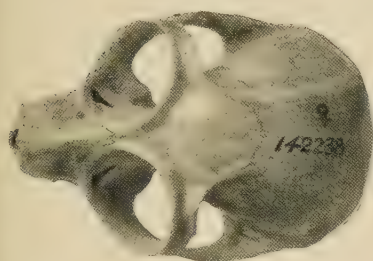
All figures about  $\frac{3}{8}$  natural size.

Figs. 1-4, *Nycticebus borneanus*, showing progressive increase in size, and the development of the temporal ridges with increasing age.

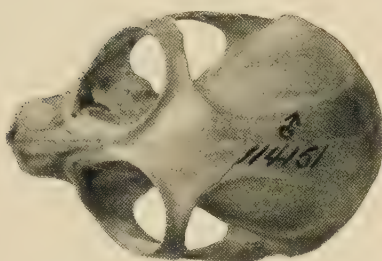
1. Adult female, Sanggau, western Borneo. Cat. No. 142238, U.S.N.M.
2. Adult female, Sanggau, western Borneo. Cat. No. 142239, U.S.N.M.
3. Old adult male, Tyan, Kapuas River, western Borneo. Cat. No. 142233, U.S.N.M.
4. Very old adult male, Sakaia River, Sanggau district, western Borneo. Cat. No. 142234, U.S.N.M., type.

Figs. 5-8, *Nycticebus malaiianus*, showing progressive increase in size, and the development of the sagittal crest with increasing age.

5. Nearly adult male, Johore Lama, Malay Peninsula. Cat. No. 114151, U.S.N.M.
6. Adult female, Rumpin River, Pahang, Malay Peninsula. Cat. No. 115496, U.S.N.M.
7. Old adult female, Tringanu, Malay Peninsula. Cat. No. 105022, U.S.N.M.
8. Old adult male, Tapanuli Bay, western Sumatra. Cat. No. 114460, U.S.N.M.



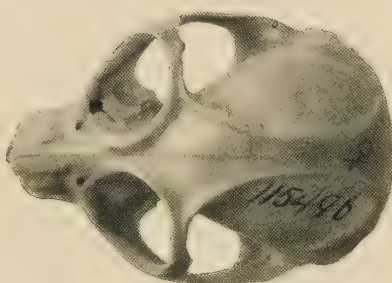
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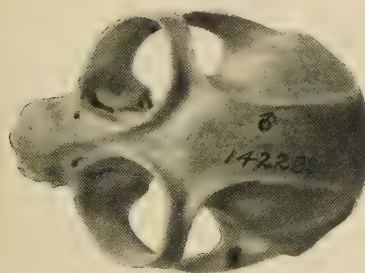
5



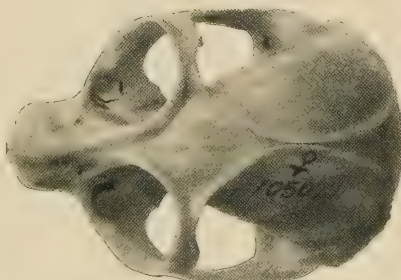
2



6



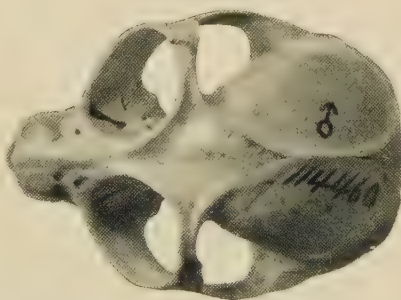
3



7



4



8

SKULLS OF SLOW LEMURS.

FOR EXPLANATION OF PLATE SEE PAGE 538.





# ANATOMICAL OBSERVATIONS ON A COLLECTION OF ORANG SKULLS FROM WESTERN BORNEO: WITH A BIBLIOGRAPHY.

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## INTRODUCTION.

In January, 1906, the United States National Museum received from Dr. W. L. Abbott 26 orang skulls, 24 of which were collected along the Sakaïam River, in Landak, western Borneo, the remaining two being from the Landak River, in the same region. The Sakaïam is a large tributary of the lower Kapuas; it flows from the southern slopes of the elevations that form the southwestern boundary of Sarawak, and joins the Kapuas at Sangau, very near the equator and at about 110° 40' east longitude.

Doctor Abbott's collection of orang skulls is probably the largest yet made in that region. Selenka's great collection in Munich includes 22 "Landak" orang skulls, but the exact location is not given; the rest of Selenka's abundant material was derived entirely from the territory of the Ketungan stream, lying considerably to the northeastward of the Sakaïam.

Only four of Doctor Abbott's specimens are fresh, the apes having been killed by his hunters; the expedition was made in the dry season, after the orangs had abandoned the lowlands along the rivers, where the wild fruits had become exhausted. The additional crania were obtained from a Dyak house, where, according to the custom of the natives, they had been hung up as trophies, the animals having been killed, cooked, and eaten. Most of these older specimens were only slightly damaged and remain fit for study. No one of the skulls is altered through any pathological condition.

Anatomical description of the above-named specimens seems desirable for several reasons. This is a large collection from a limited locality, representing, very probably, one species or "race" of the apes. The results of the study should contribute to the anatomical knowledge of orang crania in general, augment the value of the data accumulated

by Dumortier, Delisle, Owen, Selenka, Walkhoff, etc., for anthropological comparisons, and also form a basis for the collation of orang skulls from other localities.

The question as to which species of orangs the crania belong must for the present remain unanswered, on account of the existing uncertainties as to the species-distinguishing marks on the skull. Presumably, the animals are nearest related to the "Landak race" of Selenka.

The technical terms in the description are those that are in general use in craniometry and anatomy.<sup>a</sup>

#### OBSERVATIONS.

*Age.*—The first problem in the examination of Doctor Abbott's series was how to determine the fully adult skulls from those of younger animals. It was found that:

(1) No reliance can be placed on the condition of the sutures of the cranial vault as indicative of age. The lambdoid and then the sagittal, both of which in man remain open long into adult life, in the orangs begin to synostose even before the completion of the second dentition; and the coronal, in its superior half, soon follows in occlusion upon the sagittal suture. The inferior portion of the coronal and the temporo-parietal articulation are more stable and become fully obliterated only about the time when other signs indicate that the growth of the animal has been completed. Thus it is only the state of these last two sutures that may aid in determining the adult period.

(2) The facial sutures remain patent longer than most of those of the cranial vault. The first to synostose is the intermaxillary articulation, the next those of the malar bone, and last of all the nasal, and pieces of one or two orbital sutures. The closure of the intermaxillary articulation precedes the attainment of full growth; that of the malar sutures is about cotemporary; while parts of the nasal articulations and an orbital segment or two may persist open for some time after the adult stage of life has been attained.

(3) Obliteration of the basilar suture seems to correspond very closely with the reaching of full growth, and, as in man, it will be found of all the signs the most reliable in separating adult from younger orang crania.

(4) The completion of the second dentition in orangs is not a criterion that the adult life has been reached, for it takes place before the full growth of the animal is achieved. The wear and pitting of the teeth begin also during adolescence, soon after the eruption of the third molars.

(5) In males the fusion of the temporal ridges and the formation therefrom of a sagittal crest appear to correspond closely with reach-

<sup>a</sup> See Quain's or Cunningham's Anatomy, or Topinard's Anthropology.

ing the adult stage. In females this sign is much less accentuated and is not to be relied upon.

By the above distinguishing marks Doctor Abbott's collection is separable into one young, twelve adolescents, and thirteen adults.

Among the adolescents the second dentition (32 teeth) is fully completed in ten; while in two (Cat. Nos. 142183, and 142200), the third molars are still wholly in their sockets. Of the adult crania several show signs of aging, but none of advanced senility.

*Sex.*—The principal signs which characterize the adult male orang skulls are a relatively greater size of the crania, great canine teeth, and a pronounced sagittal crest; while the jaws, particularly the lower, the malars, zygomatic processes, supraorbital ridges, lambdoid crest, and the face, vault, and base as a whole, are larger and heavier than in the females. Judging by these characteristics, the collection contains thirteen male and eleven female skulls; in one specimen (Cat. No. 142184), after repeated examinations, the sex remains doubtful.

The angle of the lower jaw," which in man is a good sexual character, can not be much relied upon in differentiating orang skulls, as will be seen from the following table:

*Mandibular angle in orangs.*

| Cat. No.      | Sex.       | Stage of life.         | Angle.  | Cat. No.      | Sex.         | Stage of life.     | Angle.  |
|---------------|------------|------------------------|---------|---------------|--------------|--------------------|---------|
| 142183 .....  | Male ..... | Adolescent .....       | 107°    | 142201 .....  | Female ..... | Adolescent .....   | 103°    |
| 142195 .....  | do .....   | do .....               | 117     | 142202 .....  | do .....     | do .....           | 113     |
| 142188 .....  | do .....   | do .....               | 110     | 142170 .....  | do .....     | Near adult .....   | 110     |
| 142200 .....  | do .....   | do .....               | 106     | 142169 .....  | do .....     | Adult .....        | 116     |
| 142181 .....  | do .....   | Near adult .....       | 112     | 142187 .....  | do .....     | do .....           | 111     |
| 142196 .....  | do .....   | Just about adult ..... | 108     | 142182 .....  | do .....     | do .....           | 106     |
| 142198 .....  | do .....   | do .....               | 105     | 142190 .....  | do .....     | do .....           | 108     |
| 142194 .....  | do .....   | Adult .....            | 111     | 142191 .....  | do .....     | Adult(aging) ..... | 116     |
| 142192 .....  | do .....   | do .....               | 108     |               |              |                    |         |
| 142199 .....  | do .....   | do .....               | 1.2     |               |              |                    |         |
| 142189 .....  | do .....   | Adult(aging) .....     | 101     |               |              |                    |         |
| Average ..... |            |                        | 109     | Average ..... |              |                    | 111     |
| Range .....   |            |                        | 101-117 | Range .....   |              |                    | 106-116 |

The average difference between the two sexes is seen to amount to scarcely 2 degrees, and the ranges of individual variation overlap so greatly as to be quite similar.

In No. 142184, which by the size of the canines approaches the male but by other characteristics is nearer the female skulls, the angle is 114°. In the young specimen (Cat. No. 142171), a female having all the teeth of the first dentition but only the first molars and the left lower lateral incisor of the second dentition, the angle measures 112°.

<sup>a</sup> Measured on Broca's mandibular goniometer.

## CRANIAL CAPACITY.

The cranial cavity appears to have reached the limit of its expansion in nearly all the specimens, so that it is not necessary to exclude more than one (Cat. No. 142171) from comparison.

The method used in determining the capacity was that described by the writer on a former occasion,<sup>a</sup> and the results correspond closely with the absolute volume of the cranial cavity. To insure accuracy four determinations were made on each skull. The results were as follows:

*Cranial capacity.*

| Cat. No. | Sex. | Age.              | Cubic centimeters. | Cat. No. | Sex.   | Age.          | Cubic centimeters. |
|----------|------|-------------------|--------------------|----------|--------|---------------|--------------------|
| 142183   | Male | Adolescent        | 440                | 142201   | Female | Adolescent    | 400                |
| 142195   | do   | do                | 510                | 142202   | do     | do            | 360                |
| 142188   | do   | do                | 465                | 142193   | do     | Near adult    | 325                |
| 142197   | do   | Near adult        | 435                | 142170   | do     | do            | 340                |
| 142181   | do   | do                | 425                | 142169   | do     | Adult         | 345                |
| 142196   | do   | Just about adult. | 465                | 142185   | do     | do            | 350                |
| 142198   | do   | do                | 450                | 142187   | do     | do            | 335                |
| 142194   | do   | Adult             | 405                | 142182   | do     | do            | 340                |
| 142192   | do   | do                | 480                | 142190   | do     | do            | 320                |
| 142199   | do   | do                | 430                | 142186   | do     | Adult (aging) | 380                |
| 142189   | do   | Adult (aging)     | 415                | 142191   | do     | do            | 390                |
| Average. |      |                   | 450                | Average. |        |               | 353                |
| Range    |      |                   | 405-540            | Range    |        |               | 320-400            |

In Cat. No. 142184, the skull of the adolescent orang, the sex of which is doubtful, the capacity is 450 cc.

The writer searched the literature for other determinations of this measurement and found a number of records, which it will be of interest to introduce here for comparison. The capacities were obtained by different but related methods, and are capable of collation.

*Former measurements of cranial capacity in full-grown orangs, with known sex:*

Lucae,<sup>b</sup> two adult males: in one "the cranial cavity takes 12 ounces," the other "not quite 12 ounces," of millet seed.

Owen, R.,<sup>c</sup> one adult male, 26 cubic inches; one adult female, 24 cubic inches.

Lucae,<sup>c</sup> 1 orang, probably adult, 450 cc.; 1 orang, adult, 420 cc.; 1 orang, adult, 370 cc.; 1 orang, adult, 360 cc.; 1 orang, adult, 335 cc.

Duvernoy,<sup>c</sup> one orang, adult, 475 cc.; one orang, adult, 460 cc.

Krauss,<sup>c</sup> one orang, adult, 480 cc.

<sup>a</sup> A Modification in Measuring Cranial Capacity, *Science*, n. s., XVII, pp. 1011-1014, June 26, 1903.

<sup>b</sup> J. Ch. G. Lucae, *Der Pongo—und der Orang—Schädel in Bezug auf Species und Alter*, *Auftr. d. Senckenberg. naturf. Gesellsch.*, F. Tiedemann gewidmet, 10 Marz, 1854, pp. 154-167.

<sup>c</sup> *Trans. Zool. Soc.*, London, IV, 1862, p. 86.



Welcker,<sup>a</sup> one orang, adult, 460 cc.; one orang, nearly adult, 450 cc.; one orang, adult, 390 cc.

Bischoff,<sup>b</sup> one orang, adult, 575 cc.; one orang, adult, 370 cc.; 1 orang, adult, 325 cc.

Topinard,<sup>c</sup> three orangs, males, adult, 439 cc. (433–478 cc.); one orang, female, adult, 418 cc.

Vogt,<sup>d</sup> eight orangs, males, 448 cc. (390–500 cc.); seven orangs, females, 378 cc. (335–425 cc.).

Delisle,<sup>e</sup> first, 385 cc.; second, 470 cc.; third, 475 cc.; fourth, 430 cc.; fifth, 410 cc.; sixth, 395 cc.; seventh, 445 cc.; eighth, 390 cc.; ninth, 340 cc.; tenth, 355 cc.<sup>f</sup>

Selenka's measurements are as follows:

*Selenka's measurements of the cranial capacity.<sup>g</sup>*

| Race.                             | Total number of skulls. | Males—adults.              |         | Females—adults.            |         |
|-----------------------------------|-------------------------|----------------------------|---------|----------------------------|---------|
|                                   |                         | Average cubic centimeters. | Range.  | Average cubic centimeters. | Range.  |
| Batangu.....                      | 14                      | 430                        | 380–460 | 360                        | 330–380 |
| Dadap.....                        | 38                      | 500                        | 410–534 | 430                        | 400–490 |
| Genepai.....                      | 22                      | 390                        | 360–430 | 370                        | 350–410 |
| Landak.....                       | 22                      | 430                        | 410–440 | 370                        | 350–400 |
| Rantai.....                       | 2                       | .....                      | .....   | 335                        | 321–349 |
| Skalau.....                       | 89                      | 440                        | 370–500 | 370                        | 300–450 |
| Tunak.....                        | .....                   | .....                      | .....   | (?)                        | 400–470 |
| Wallaces.....                     | 6                       | .....                      | .....   | (?)                        | 310–360 |
| <i>Sumatranus deliensis</i> ..... | 5                       | (?)                        | 385–445 | (1)                        | 340     |

<sup>a</sup> In C. Vogt, Ueber die Microcephalen oder Affen-menschen, Arch. f. Anthropol., II, 1867, p. 185.

<sup>b</sup> Th. L. Bischoff, Ueber die Verschiedenheit in der Schädelbildung des Gorilla, Schimpanse und Orang-Utan, München, 1867, p. 29. Measured with millet seed; gives the largest as female, but from description it is clear it was that of a male.

<sup>c</sup> P. Topinard, Anthropology, London, 1878, p. 48. Capacity determined by "small shot." (Probably Broca's method.)

<sup>d</sup> Idem, p. 49. Used millet seed principally.

<sup>e</sup> F. Delisle, Notes sur l'ostéométrie et la craniologie des orang-outans, Nouv. Arch. du Mus. d'hist. nat., 3d ser., VII, Paris, 1895, p. 106. Used Broca's method, which gives slightly exaggerated results.

<sup>f</sup> Only one of these ten appeared to be that of a female.

<sup>g</sup> E. Selenka.—Studien ueber Entwicklungsgeschichte der Tiere, 6, Menschenaffen, Wiesbaden, 1898, p. 8. Measured by Ranke's method, with millet seed. Gives also the following data as to the young. For other results in young, see C. Vogt, Ueber die Microcephalen oder affen Menschen, Arch. f. anthropol., II, 1867, p. 185.

*Selenka: Young (Skalau), males.*

Cubic centimeters.

|                                                                                      |         |
|--------------------------------------------------------------------------------------|---------|
| 1. No teeth as yet.....                                                              | 292     |
| 2. All teeth of first dentition except canines.....                                  | 297     |
| 3. All teeth of first dentition.....                                                 | 313     |
| 4–7. All first molars of second dentition visible, deep.....                         | 363–368 |
| 8. All first molars of second dentition erupted.....                                 | 400     |
| 9–13. All first molars of second dentition erupted, second molars visible, deep..... | 378–400 |

On combining these data on cranial capacity in full-grown oranges it is found that the measurement ranges in the males from 355 (Delisle) to 540 (Abbott) and even 575 (Bischoff), and in the females from 300 (Selenka) to 490 (Selenka), which is a great variation. The greatest and smallest capacities in the Abbott series are not attended with any other structural peculiarities which would point to animals belonging to distinct species, and must be ascribed solely to individual diversity.

#### LINEAR DIMENSIONS AND FORM OF THE SKULL.

Measurements of the cranial vault in oranges and particularly in the males offer difficulties which are not encountered in man. The region above the nasal bone, corresponding in part to the human glabella, varies much even in the same sex and is not suitable for the anterior starting point of the long diameter of the vault. The point chosen instead was the intersection of the median line with a horizontal line obtained by passing the rod of the sliding compass down the frontal bone until it rested on the orbital arches. This point marks very nearly the anterior boundary of the vault, and corresponds closely to Broca's ophryon as well as to the point from which Schwalbe, Selenka, and Kohlbrügge measured. The length was measured from that *ad maximum*, which generally corresponds to some point on the vertical occipital ridge. The breadth was the greatest diameter at the height of the temporo-parietal sutures, the temporal bone below expanding in thickness and rendering all measurements over it impracticable. Selenka<sup>a</sup> measured the breadth in much the same manner. The height taken was the standard one, basion to bregma (or where crest existed to its base over bregma). The following table gives the results of these measurements:

#### Cranial measurements.

| Male oranges. |            |            |                                      |            | Female oranges. |            |            |                                      |            |
|---------------|------------|------------|--------------------------------------|------------|-----------------|------------|------------|--------------------------------------|------------|
| Cat. No.      | Length.    | Breadth.   | Length-breadth index (length = 100). | Height.    | Cat. No.        | Length.    | Breadth.   | Length-breadth index (length = 100). | Height.    |
|               | <i>Cm.</i> | <i>Cm.</i> |                                      | <i>Cm.</i> |                 | <i>Cm.</i> | <i>Cm.</i> |                                      | <i>Cm.</i> |
| 142188 .....  | 11.8       | 10.2       | 86.4                                 | 9.3        | 142201 .....    | 12.0       | 9.8        | 81.7                                 | 9.2        |
| 142195 .....  | 13.0       | 11.2       | 86.1                                 | b 11.5     | 142202 .....    | 11.3       | 9.2        | 81.4                                 | (?)        |
| 142188 .....  | 12.3       | 10.2       | 82.9                                 | 11.1       | 142193 .....    | 11.2       | 9.2        | 82.1                                 | 9.1        |
| 142200 .....  | (?)        | 10.0       | (?)                                  | 9.4        | 142170 .....    | 11.2       | 9.2        | 82.1                                 | 9.3        |
| 142197 .....  | 12.1       | 10.3       | 85.1                                 | (?)        | 142169 .....    | 11.3       | 9.3        | 82.3                                 | 9.2        |
| 142180 .....  | (?)        | 10.0       | (?)                                  | (?)        | 142185 .....    | 11.5       | 8.9        | 77.4                                 | 9.4        |
| 142181 .....  | 11.9       | 9.4        | 79.0                                 | 9.5        | 142187 .....    | 11.2       | 9.1        | 81.2                                 | 8.8        |
| 142196 .....  | 12.1       | 9.7        | 80.2                                 | (?)        | 142182 .....    | 11.5       | 9.8        | 85.2                                 | 8.9        |
| 142198 .....  | 12.6       | 10.0       | 79.4                                 | 10.3       | 142190 .....    | 11.2       | 9.2        | 82.1                                 | 9.0        |
| 142194 .....  | 12.3       | 9.7        | 78.9                                 | 9.5        | 142186 .....    | 11.7       | 9.6        | 82.0                                 | 8.6        |
| 142192 .....  | 12.7       | 10.0       | 78.7                                 | b 10.0     | 142191 .....    | 11.8       | 9.5        | 80.5                                 | 8.7        |
| 142199 .....  | 12.1       | 9.8        | 81.0                                 | b 9.6      |                 |            |            |                                      |            |
| 142189 .....  | 12.4       | 9.4        | 75.8                                 | b 9.2      |                 |            |            |                                      |            |
| Average.      | 12.5       | 10.0       | 80.0                                 | 9.9        |                 | 11.4       | 9.3        | 81.7                                 | 9.0        |
| Range .....   | 11.8       | 9.4        | 75.8                                 | 9.2        |                 | 11.2       | 8.9        | 77.4                                 | 8.6        |
|               | 13.0       | 11.2       | 86.4                                 | 11.5       |                 | 12.0       | 9.8        | 85.2                                 | 9.4        |
|               |            |            |                                      |            |                 |            |            |                                      |            |

<sup>b</sup> Approximately.

<sup>a</sup> Studien ueber Entwicklungsgeschichte der Tiere, 1898, pp. 22, 23.

The data show, in conformity with those on capacity, that in orangs the cranial vault grows very little after the eruption of the third permanent molars. The cranial index in half of the males and nearly all the females is moderately brachycephalic, in the other half of the males and one female mesocephalic. The predominance of moderate brachycephaly agrees with former observations. In the males the index appears to decrease somewhat with growth, which is largely due to the increasing thickness of the vertical occipital ridge; in the females such difference is not noticeable. The height shows a reciprocal compensation with the breadth. On the average, the female skull is both absolutely and relatively lower than that of the male. (Height-length index, male 81, female 78; Height-breadth index, male 99, female 96.) The range of variation, except with the cephalic index in the males, can not be regarded as excessive.

#### MEASUREMENTS OF THE FACE.

The lower jaw attains in the males remarkable proportions, showing at the same time more variation than does that of the females. The height of the symphysis, from the highest point of the alveolar process in the median line perpendicularly downward,<sup>a</sup> measured as follows:

| Cat. No. | Male lower jaws. | Vertical height of symphysis. | Cat. No. | Female lower jaws. | Vertical height of symphysis. |
|----------|------------------|-------------------------------|----------|--------------------|-------------------------------|
|          |                  | Cm.                           |          |                    | Cm.                           |
| 142183   | .....            | 4.4                           | 142201   | .....              | 4.5                           |
| 142195   | .....            | 5.6                           | 142202   | .....              | 4.5                           |
| 142188   | .....            | 5.6                           | 142184   | .....              | 4.3                           |
| 142200   | .....            | 5.3                           | 142170   | .....              | 4.4                           |
| 142197   | .....            | 6.4                           | 142169   | .....              | 4.9                           |
| 142180   | .....            | 5.9                           | 142187   | .....              | 5.2                           |
| 142181   | .....            | 5.2                           | 142182   | .....              | 4.5                           |
| 142196   | .....            | 6.0                           | 142190   | .....              | 4.4                           |
| 142198   | .....            | 5.7                           | 142191   | .....              | 4.5                           |
| 142194   | .....            | 6.9                           |          |                    |                               |
| 142192   | .....            | 5.8                           |          |                    |                               |
| 142199   | .....            | 6.2                           |          |                    |                               |
| 142189   | .....            | 6.5                           |          |                    |                               |
| Average  | .....            | 5.9                           | Average  | .....              | 4.6                           |
| Range    | .....            | 5.2-6.9                       | Range    | .....              | 4.3-5.2                       |

Some of these mandibles are really very large; thus, No. 142194 measures, in line with the border of the alveolar process, 16.4 cm. in length with the vertical ramus 10.5 cm. high and 6.15 cm. in minimum breadth; and it weighs, less both canines and three incisors, 344 grams.

The data concerning the angle of the lower jaw were given before. (See under sex.)

Two measurements were taken on the upper portion of the face, namely, (1) the height from the lowest point on the upper alveolar border to the highest point of the naso-frontal suture, and (2) the diameter bizygomatic maximum. Both of these measure-

<sup>a</sup> On Broca's mandibular goniometer.

ments are used extensively in anthropometry and their relation  $\left( \frac{\text{facial height, upper,} \times 100}{\text{diam. bizygomatic max.}} \right)$  gives the upper facial index of Kollmann. Doctor Abbott's series of orangs shows in these particulars as follows:

*Facial dimensions.*

| Male orangs. |                              |                                          |                              | Female orangs. |                              |                                          |                            |
|--------------|------------------------------|------------------------------------------|------------------------------|----------------|------------------------------|------------------------------------------|----------------------------|
| Cat. No.     | Height<br>(alveolar-nasion). | Breadth<br>(diam. bizygomatic<br>maxim). | Index.                       | Cat. No.       | Height<br>(alveolar-nasion). | Breadth<br>(diam. bizygomatic<br>maxim). | Index.                     |
|              | <i>Cm.</i>                   | <i>Cm.</i>                               |                              |                | <i>Cm.</i>                   | <i>Cm.</i>                               |                            |
| 142183 ..... | 7.9                          | 12.7                                     | 62.2                         | 142201 .....   | 8.0                          | 12.4                                     | 64.5                       |
| 142195 ..... | 10.4                         | 14.5                                     | 71.7                         | 142202 .....   | 8.0                          | 12.4                                     | 64.5                       |
| 142188 ..... | 10.6                         | 15.3                                     | 69.3                         | 142193 .....   | 9.2                          | 13.0                                     | 70.8                       |
| 142200 ..... | 10.3                         | 14.7                                     | 70.1                         | 142170 .....   | 9.4                          | 13.2                                     | 71.2                       |
| 142197 ..... | 11.8                         | 16.5                                     | 71.5                         | 142169 .....   | 10.1                         | 13.4                                     | 75.4                       |
| 142180 ..... | 11.4                         | 16.3                                     | 69.9                         | 142185 .....   | 8.9                          | 12.8                                     | 69.5                       |
| 142181 ..... | 11.3                         | 16.1                                     | 70.2                         | 142187 .....   | 9.9                          | 13.2                                     | 75.0                       |
| 142196 ..... | 11.2                         | 17.3                                     | 64.7                         | 142182 .....   | 8.8                          | 13.5                                     | 65.2                       |
| 142198 ..... | 12.3                         | 16.7                                     | 73.6                         | 142190 .....   | 9.2                          | 13.3                                     | 69.2                       |
| 142194 ..... | 12.1                         | 16.9                                     | 71.6                         | 142186 .....   | 9.4                          | 13.1                                     | 71.8                       |
| 142192 ..... | 12.4                         | 16.9                                     | 73.4                         | 142191 .....   | 8.4                          | 12.4                                     | 67.7                       |
| 142199 ..... | 12.4                         | 16.5                                     | 75.1                         |                |                              |                                          |                            |
| 142189 ..... | 10.9                         | 16.7                                     | 65.3                         |                |                              |                                          |                            |
| Average...   | { (of lower 9)<br>(9) 11.8   | { (of lower 9)<br>(9) 16.7               | { (of lower 12)<br>(12) 70.5 | Average...     | { (of lower 9)<br>(9) 9.3    | { (of lower 9)<br>(9) 13.1               | { (of lower 9)<br>(9) 70.6 |
| Range...     | { 10.9-12.4                  | { 16.1-17.3                              | { 64.7-75.1                  | Range...       | { 8.4-10.1                   | { 12.4-13.5                              | { 65.2-75.4                |

<sup>a</sup> Lowest point in the median line of the upper alveolar process.

The males and females are seen to differ greatly in absolute size, but the relative proportions (upper facial indices) are, in average, as well as in range, almost identical. Quite an extensive variation in size and shape exists in both sexes. The male crania show that facial growth in that sex does not cease before the apes become fully adult.

Comparison of the facial with the cephalic index, given in the following table, displays a lack of correspondence; the facial growth is apparently controlled, unlike in man, much more by the development of the teeth and facial muscles than by that of the cranial vault.

*Facial compared with cephalic index.*

| Males. |       |       |       | Females. |       |       |       |
|--------|-------|-------|-------|----------|-------|-------|-------|
| F. I.  | C. I. | F. I. | C. I. | F. I.    | C. I. | F. I. | C. I. |
| 62.2   | 86.4  | 73.6  | 79.4  | 64.5     | 81.7  | 75.0  | 81.2  |
| 71.7   | 86.1  | 71.6  | 78.9  | 70.8     | 82.1  | 65.2  | 85.2  |
| 69.3   | 82.9  | 73.4  | 78.7  | 71.2     | 82.1  | 69.2  | 82.1  |
| 71.5   | 85.1  | 75.1  | 81.0  | 75.4     | 82.3  | 71.8  | 82.0  |
| 70.2   | 79.0  | 65.3  | 75.8  | 69.5     | 77.4  | 67.7  | 80.5  |
| 64.7   | 80.2  |       |       |          |       |       |       |

*Facial prognathism* is very largely alveolar. In some of the orang skulls of Doctor Abbott's series (as, for instance, in No. 142189) this is so marked that the face from above downward presents a decided con-



cavity. The maximum of the protrusion is reached with the completion of the second dentition; and contrary to what is observed in man, but in accord with the differences in the size of the teeth, the prognathism is generally greater in the male. The next table gives the gnathic index of the various skulls, obtained by the method of Flower

$$\left( \frac{\text{basi-alveolar length} \times 100}{\text{basi-nasal length}} \right).$$

*Measurements of prognathism.*

| Male orangs.                                      |                       |                       |                         | Female orangs.                                    |                       |                       |                |
|---------------------------------------------------|-----------------------|-----------------------|-------------------------|---------------------------------------------------|-----------------------|-----------------------|----------------|
| Cat. No.                                          | Basion-alveon length. | Basion-nasion length. | Gnathic index (Flower.) | Cat. No.                                          | Basion-alveon length. | Basion-nasion length. | Gnathic index. |
|                                                   | <i>Cm.</i>            | <i>Cm.</i>            |                         |                                                   | <i>Cm.</i>            | <i>Cm.</i>            |                |
| 142183                                            | 13.5                  | 9.2                   | 147                     | 142201                                            | 13.3                  | 9.1                   | 146            |
| 142188                                            | 16.6                  | 10.2                  | 163                     | 142193                                            | 13.5                  | 9.0                   | 150            |
| 142200                                            | 16.3                  | 9.9                   | 165                     | 142170                                            | 14.4                  | 9.2                   | 157            |
| 142181                                            | 17.5                  | 10.4                  | 168                     | 142166                                            | 15.0                  | 9.7                   | 155            |
| 142196                                            | 16.3                  | 10.2                  | 160                     | 142185                                            | 14.4                  | 9.4                   | 153            |
| 142198                                            | 17.8                  | 10.6                  | 168                     | 142187                                            | 15.0                  | 9.4                   | 160            |
| 142194                                            | 17.0                  | 10.0                  | 170                     | 142182                                            | 14.0                  | 9.3                   | 151            |
| 142192                                            | 19.0                  | 10.8                  | 176                     | 142190                                            | 13.7                  | 8.9                   | 154            |
| 142199                                            | 17.2                  | 9.9                   | 174                     | 142186                                            | 14.0                  | 9.0                   | 156            |
| 142189                                            | 17.6                  | 10.6                  | 166                     | 142191                                            | 14.4                  | 9.2                   | 157            |
| Average. { of lower 7 } of lower 7 } of lower 7 } |                       |                       |                         | Average. { of lower 9 } of lower 9 } of lower 9 } |                       |                       |                |
| Range .. { 17.5 } 10.4 } 169                      |                       |                       |                         | Range ... { 14.3 } 9.2 } 155                      |                       |                       |                |
| Range .. { 16.3 } 9.9 } 160                       |                       |                       |                         | Range ... { 13.5 } 8.9 } 150                      |                       |                       |                |
| Range .. { 19.0 } 10.8 } 176                      |                       |                       |                         | Range ... { 15.0 } 9.7 } 160                      |                       |                       |                |

The most prognathic female, it is seen, just reaches the grade of facial protrusion observed in the least prognathic male. It will also be observed that the males show again a greater variation.

*Orbits.*—The orbits are, with one single exception, all of greater height than breadth. The rare, if not unique exception in orangs, is the right orbit of No. 142196, the index of which is 98.6, approaching the megaseme orbits of human crania; the right orbit shows in general a slight tendency to an excess over the left in breadth combined with a defect in height. The same phenomena is present in man, where it is accompanied by, and probably stands in some connection with, a perceptibly greater obliquity of the right palpebral fissure. The average orbital index does not differ much in the two sexes, especially after full growth. The two extremes of shape among the females occur in the two youngest specimens. Both the index and the absolute proportions show a large range of individual variation.

## Measurements of orbits.

| Male oranges.     |                      |            |                       |            |             | Female oranges.   |            |            |            |            |             |
|-------------------|----------------------|------------|-----------------------|------------|-------------|-------------------|------------|------------|------------|------------|-------------|
| Catalogue number. | Height. <sup>a</sup> |            | Breadth. <sup>b</sup> |            | Mean index. | Catalogue number. | Height.    |            | Breadth.   |            | Mean index. |
|                   | Right.               | Left.      | Right.                | Left.      |             |                   | Right.     | Left.      | Right.     | Left.      |             |
|                   | <i>Cm.</i>           | <i>Cm.</i> | <i>Cm.</i>            | <i>Cm.</i> |             |                   | <i>Cm.</i> | <i>Cm.</i> | <i>Cm.</i> | <i>Cm.</i> |             |
| 142183 .....      | 3.80                 | 3.80       | 3.35                  | 3.30       | 115.2       | 142171 .....      | 3.45       | 3.50       | 3.05       | 3.05       | 129.5       |
| 142195 .....      | 3.85                 | 3.90       | 3.30                  | 3.20       | 119.2       | 142201 .....      | 3.50       | 3.50       | 3.45       | 3.40       | 100.7       |
| 142188 .....      | 4.00                 | 4.00       | 3.55                  | 3.45       | 114.3       | 142202 .....      | 3.50       | 3.55       | 3.15       | 3.15       | 111.9       |
| 142200 .....      | 4.15                 | 4.15       | 3.50                  | 3.50       | 118.6       | 142193 .....      | 3.55       | 3.55       | 3.15       | 3.00       | 115.4       |
| 142197 .....      | 4.10                 | 4.20       | 3.50                  | 3.35       | 121.3       | 142170 .....      | 3.90       | 3.90       | 3.40       | 3.40       | 114.7       |
| 142180 .....      | 4.20                 | 4.15       | 3.70                  | 3.50       | 113.1       | 142169 .....      | 3.75       | 3.80       | 3.40       | 3.40       | 114.0       |
| 142181 .....      | 3.90                 | 3.80       | 3.35                  | 3.35       | 114.9       | 142185 .....      | 3.80       | 3.80       | 3.05       | 3.10       | 123.6       |
| 142196 .....      | 3.50                 | 3.75       | 3.55                  | 3.40       | 104.3       | 142187 .....      | 4.00       | 3.95       | 3.45       | 3.40       | 116.1       |
| 142198 .....      | 4.55                 | 4.60       | 3.65                  | 3.65       | 125.2       | 142182 .....      | 3.60       | 3.70       | 3.25       | 3.25       | 112.3       |
| 142194 .....      | 4.10                 | 4.05       | 3.50                  | 3.45       | 117.3       | 142190 .....      | 3.70       | 3.75       | 3.05       | 3.10       | 121.1       |
| 142192 .....      | 4.15                 | 4.15       | 3.55                  | 3.55       | 116.9       | 142186 .....      | 3.90       | 3.90       | 3.25       | 3.05       | 123.8       |
| 142199 .....      | 3.95                 | 3.90       | 3.55                  | 3.60       | 109.8       | 142191 .....      | 3.70       | 3.80       | 3.20       | 3.10       | 119.0       |
| 142189 .....      | 4.10                 | 4.10       | 3.35                  | 3.35       | 122.4       |                   |            |            |            |            |             |
| Average .....     | 4.03                 | 4.04       | 3.49                  | 3.43       | 116.5       | Average .....     | 3.74       | 3.77       | 3.23       | 3.19       | 116.8       |
| Range .....       | 3.50                 | 3.75       | 3.30                  | 3.20       | 104.3       | Range .....       | 3.50       | 3.50       | 3.05       | 3.00       | 111.9       |
|                   | 4.55                 | 4.60       | 3.70                  | 3.65       | 125.2       |                   | 4.00       | 3.95       | 3.45       | 3.40       | 123.8       |

<sup>a</sup> From about the middle of the lower boundary of the orbit to the highest point above. There is often at the lower edge a slight eversion, or bevelling, which must be neglected, the true boundary of the orbit being just posterior to it.

<sup>b</sup> From a point of meeting of the mesial part of the boundary of the orbit and the fronto-maxillary suture, a landmark which corresponds near to dacryon in man, to the most distant point on the external boundary line of the orbit. Both measurements are conveniently taken with the graduated shaft of the sliding compass, whose extremity has been sharpened, and are, with the index, directly comparable with those obtained by Broca's method in man.

The orbital height follows to a certain extent the growth of the length of the face, but it also bears a special relation to age and particularly to sex. It is, relatively to the facial length, somewhat greater in the young and in the females than in the adults and in the males.

The following table shows these conditions quite clearly:

*Relation of the mean height of the orbits to the upper length of the face. Length of the face = 100.*

| Male oranges.     |                      |        |                         | Female oranges.   |                      |        |                      |
|-------------------|----------------------|--------|-------------------------|-------------------|----------------------|--------|----------------------|
| Catalogue number. | Orbito-facial index. | No.    | Index.                  | Catalogue number. | Orbito-facial index. | No.    | Index.               |
| 142183 .....      | 48.1                 | 142196 | 32.3                    | 142171 .....      | 43.4                 |        |                      |
| 142195 .....      | 37.2                 | 142198 | 37.1                    | 142201 .....      | 43.7                 | 142187 | 40.1                 |
| 142188 .....      | 37.7                 | 142194 | 33.6                    | 142193 .....      | 38.6                 | 142182 | 41.5                 |
| 142200 .....      | 40.3                 | 142192 | 33.5                    | 142170 .....      | 41.5                 | 142190 | 40.4                 |
| 142197 .....      | 35.2                 |        |                         | 142169 .....      | 37.3                 | 142186 | 41.5                 |
| 142180 .....      | 36.6                 | 142199 | 31.6                    | 142185 .....      | 42.7                 | 142191 | 44.6                 |
| 142181 .....      | 34.1                 | 142189 | 37.6                    |                   |                      |        |                      |
| Average .....     |                      |        | { (of lower 12)<br>35.5 |                   |                      |        | { (of lower 9)<br>41 |
| Range .....       |                      |        | 31.6-40.3               |                   |                      |        | 37.3-44.6            |

## ADDITIONAL CHARACTERISTICS.

The *ramus* of the orang skulls has, when viewed from above, a pyri-form shape, the smaller extremity corresponding to that part which lies immediately posterior to the orbits. The outline of the lateral plane is oval, while that of the norma occipitalis, without the crests, is intermediary between quadrilateral and circular, never pentagonal as in man.

The forehead, while more or less sloping backward, shows always a good median convexity; in the old males, however, this is nearly obscured by the approximated and prominent temporal ridges.

The features of the vault of paramount interest are the temporal ridges, and the various aspects under which they were found gave rise to much confusion in the earlier contributions on orang craniology and orang species. Doctor Abbott's series of crania shows clearly many important points concerning these features. Up to the completion of permanent dentition the temporal lines are seen to be well apart all along the median line and resemble in every way those in man. During late adolescence, however, these ridges show a rapid approach toward the interparietal articulation and develop into lines of pronounced roughness in the females and into irregularly elevated ridges in the males. In most females they evolve no further than just indicated (as, for example, in Nos. 142193, 142169, 142185, 142186, and 142191), but in some they approach near to junction in the median line (No. 142190), and in others they join for a variable distance from the vertex to the obelion and form a single, low (1 to 3 mm.), sagittal crest, which sometimes shows by a median groove the line of previous separation (Nos. 142170, 142187, and 142182). In males of this series the junction of the advancing rough lines or ridges has taken place in all that reached very near or into adult life (Nos. 142181 to 142189), forming eventually a pronounced sagittal crest which extends over a part of the frontal bone, rises at its highest point to from 1 to 2 cm. in height, and offers a greatly enlarged surface for the attachment of the temporal muscles.

The gradual advance mesiad of the two temporal ridges with the development of the muscles of mastication, the formation at last of the single crest, and the complete disappearance of all traces of the earlier ridges over the parietal bones, constitute a series of the most interesting phenomena in the morphology of the orang skull; and they throw at the same time light on the origin and significance of those abnormally high temporal ridges met with in other animals, and occasionally in the human cranium.<sup>a</sup>

The *lambdoid crests*, serving for the attachment of temporal as well as occipital muscles, develop in both sexes of orangs much earlier than the sagittal. They reach jointly from mastoid to mastoid, forming at lambda a pronounced, rough, triangular tuberosity. In males these crests also, like the sagittal ones, reach much greater proportions than in females. They cause a very early closure of the lambdoid suture.

The *vertical occipital ridge* is comparatively moderate, probably never rising above 4 mm. above the surface of the neighboring bone, and usually being lower. It is more developed in the males.

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<sup>a</sup>See A Painted Skeleton from Northern Mexico, by the present writer, *American Anthropologist*, n. s., III, September-December, 1901.

The *supraorbital ridges*, pronounced in both sexes, are seldom very heavy. They show a marked difference from those in man, consisting in their tapering toward the median line and enlarging outward, up to the malo-frontal suture; in man these ridges are generally most pronounced in their mesial extremity and taper outward.

The *sutures of the vault* show well-developed, often very fine and complex (sagittal and lambdoid), serration. The coronal, the most simple, presents below its middle, in nearly every case where the obliteration is not too advanced, a backward incurvation or angle, the sign of a fetal fontanel and a still earlier developmental separation in this location.<sup>a</sup>

The general order of *synostosis* in the sutures of the vault is lambdoid, sagittal (the two may coincide), coronal, temporo-occipital, temporo-parietal.

*Sutural and fontanel ossicles* occur not infrequently, but seem to be limited to the posterior part of the skull. There were found several small ones in each asterion in No. 142202; one at right asterion in No. 142195; one in each temporo-occipital in No. 142200; one in right temporo-occipital and one in lambdoid in 142171; three in right and two in left temporo-occipital in No. 142169; several small in right temporo-parietal in No. 142186. Several of the male and three of the female skulls showed advanced obliteration, which involved any accessory bones which may have existed.

In the skull with uncertain sex (No. 142184) there are two sutural bones in the sagittal and one ossicle in each lambdoid articulation, and several in and about each asterion. Other larger sutural bones existed in this specimen along the sagittal, but their boundaries are partly obliterated; a persisting incomplete boundary of one near bregma looks at first sight like a partial parietal suture. Apparently there were in this skull disorders in ossification.

No form of *parietal division* exists in any of the twenty-four skulls.

As to *pteron* the conditions are as follows:

|                                                   | Male. | Female. |
|---------------------------------------------------|-------|---------|
| Parieto-sphenoidal articulation, both sides ..... | 6     | 5       |
| Parieto-sphenoidal articulation, right side ..... | 0     | 2       |
| Fronto-temporal articulation, both sides .....    | 3     | 0       |
| Fronto-temporal articulation, left side .....     | 0     | 2       |
| Unrecognizable because obliteration .....         | 4     | 1       |

The skull of uncertain sex (No. 142184) shows also a bilateral parieto-sphenoidal articulation. The H pterion therefore, or the form which is general in man, occurs also in a very large majority (80 per cent of all the nonobliterated articulations)<sup>b</sup> of these orangs.

<sup>a</sup> For details concerning this feature and bibliography, see A. Hrdlicka, Divisions of the Parietal Bone in Man and Other Mammals, Bull. Amer. Mus. Nat. Hist., XIX, 1903, pp. 231-383.

<sup>b</sup> Anoutchin (Bull. Soc. d'Anthrop., 1878, p. 332) in 65 orang crania found the fronto-temporal articulation on one or both sides in 29.2 per cent of the skulls. Doctor Abbott's collection, reported in similar way, shows the condition in 27.3 per cent of the skulls—results remarkably alike.



The *mastoid* is differentiated, though less so than in man; it is also larger in the males.

*Facial features.*—The nasal bone is in all the specimens single, but in several of the youngest skulls there can be traced a former median vertical fissure. In several cases the free border shows two lateral fissures, but these have nothing to do with an original, central separation of two nasal components. The bone varies more than any other part of the face in shape and breadth, though in general it tapers from below upward, with a constriction (in most specimens) near the middle. In one of the series it is quite rudimentary (fig. 1). Selenka found various grades of deficiency to a complete absence of these bones in several of his specimens.<sup>a</sup>

The nose as a whole is leptorhynic, due to the height of the face. The aperture in the nearly grown-up and adult animals differs in shape from vertically elliptical to nearly triangular; it varies in breadth in the adults from 2.5 to 3.2 cm. in the males and from 1.9 to 2.5 cm. in the females. The so-called simian gutters do not occur in the youngest female, but in the other specimens are generally present, though shallow. The inferior boundary of the nose is mostly widely convex, but in several specimens (as, for instance, in No. 142199) it is limited by an easily appreciable ridge.

Nearly all of the specimens show a more or less pronounced elevation corresponding to, and very evidently morphologically identical with, the nasal spine in human skulls.<sup>b</sup> This elevation is particularly prominent (over 3 mm. high) in the female orang (No. 142169), being fully as large and well formed as in occasional human crania (fig. 2).

The malar bones were examined particularly for divisions, but not a trace was found of either sutures or fissures. There was also a complete absence of the maxillary and zygomatic processes which, as W. Gruber first pointed out, in man frequently extend over the ventral surface of the malar, occasionally forming a complete bony arc. In No. 142169, however, are present on the right side two good-sized accessory ossicles, one in the zygomatic and the other at the inferior extremity of the malo-maxillary articulation (fig. 3).<sup>c</sup>

The symphysis of the lower jaw<sup>d</sup> is invariably receding from above

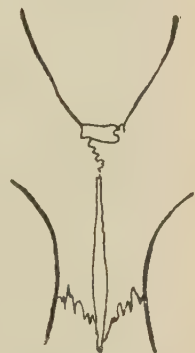


FIG. 1.—RUDIMENTARY NASAL BONE IN THE FEMALE ADULT ORANG. (Cat. No. 142191 U.S. N.M.) (Exact size).

<sup>a</sup> Menschenaffen, pp. 48, 49.

<sup>b</sup> Concerning this point see particularly E. T. Hamy, De l'épine nasale dans l'ordre des primates, Bull. Soc. d'Anthropol. de Paris, IV, 1869, pp. 13-28.

<sup>c</sup> Compare W. Gruber, in the Arch. f. Anat., Physiol., etc., 1873, p. 337.

<sup>d</sup> For detail discussion on the mandible of apes see O. Walkhoff, Der Unterkiefer des Anthropomorphen und des Menschen in seiner funktionellen Entwicklung und Gestalt, in Pt. 4 of Selenka's Studien u. Entwicklungsgeschichte d. Tiere, Wiesbaden, 1902.

downward, but the grade of the obliquity differs. The cause of this slope is, to a large extent, the great development of the alveolar process, itself due in turn to the size of the teeth. Properly speaking, we have here a high degree of mandibular prognathism. The horizontal rami pass backward with a moderate divergence, but the

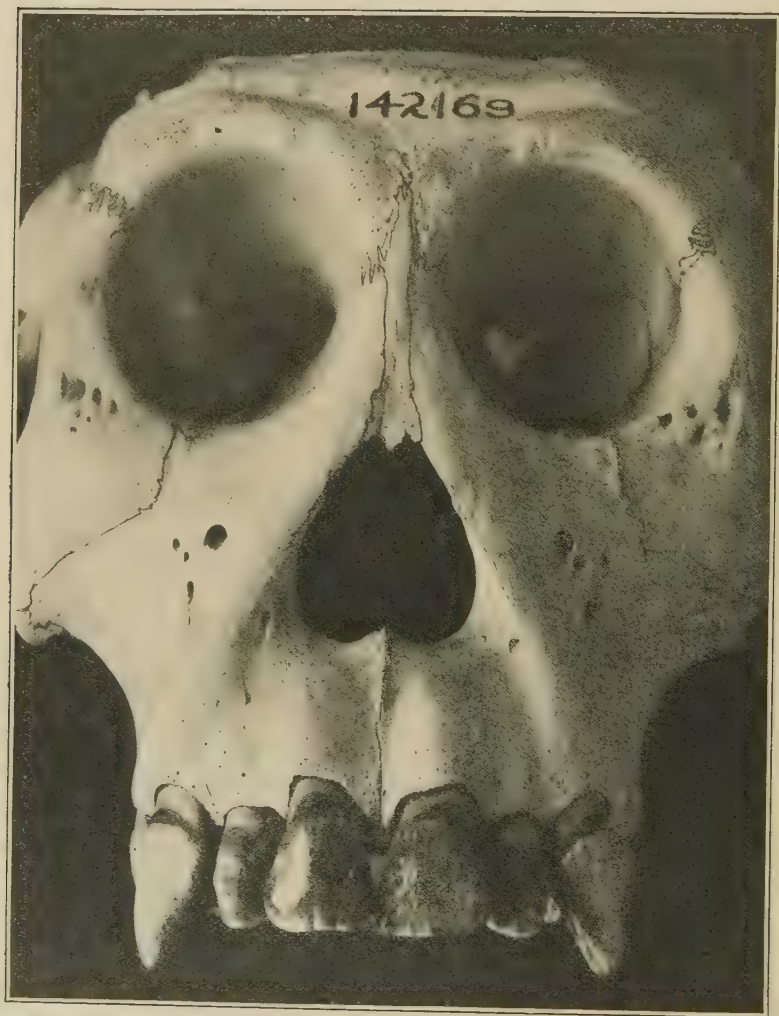


FIG. 2.—SKULL OF FEMALE ORANG SHOWING NASAL SPINE (Cat. No. 142169 U.S.N.M.).

two rows of teeth, to connect with those of the upper jaw, run nearly or entirely in parallel lines. This gives to each of the horizontal branches a rather pronounced twist, well seen from above, and adds much to the thickness of the upper border behind the second molars.

The vertical ramus in the females approaches in form the same part of the human jaw; in males the posterior border shows a marked rough curve or process, produced by the attachment of the powerful internal pterygoid muscle and the stylo-mandibular ligament.

*Base of the skull.*—The palate approaches ovoid in form—narrower behind than in front, or it is elliptical, or U-shaped. The intermaxillaries are still wholly separated in No. 142171, and the palatal part of their articulation is more or less visible in all the adolescents. The nares are spacious, of somewhat greater height than breadth. The external pterygoid plates are everted; the pterygoid fossa is sometimes deep (as, for instance, in No. 142192); sometimes very shallow (as in the case of No. 142195). The glenoids are broad and shallow, and are bounded externally by the large zygomatic tuberosity, posteriorly by a well developed post-glenoid process, and mesially by a pronounced tuberosity, formed by that part of the temporal which lies next to the petrous bone. This elevation, but feebly represented in human crania, seems to take in part the place of the spinous process, which in the orangs is nearly or wholly absent. The eminentia articularis is very low. The floor of the auditory meati shows no dehiscence.



FIG. 3.—THE RIGHT MOLAR OF FEMALE ORANG (Cat. No. 142169 U.S.N.M.), SHOWING ACCESSORY OSSICLES AT *x* AND *y*.

The surface of the basilar process is, viewing the base of the skull from above, generally on a lower level than the more elevated parts of the petrous portions of the temporal; and these portions extend forward well upon the body of the sphenoid, leaving only a small side-slit for the middle lacerated foramen. These two features, to which the writer briefly drew attention before,<sup>a</sup> constitute a very good index of the relative development of the brain and skull. In an intellectual white man the petrous portions, looked at from above, are decidedly sunken below the level of the neighboring parts, which offered less

<sup>a</sup>Certain Racial Characteristics of the Base of the Skull. (Abstract.) Rept. Section Anthropology and Psychology, N. Y. Acad. Sci., Science, Feb. 22, 1901. p. 309.



resistance than these hard wedges to the expansion of the brain; and the middle lacerated foramina are large, through the spreading of the surrounding parts, while the petrous bones remained stationary. In the African blacks the petrous portion and surface of neighboring bones are often on the level and the middle lacerated space is small, while in the Indians, brown, and some yellow races the conditions are mostly between those of the white and black. The whole process of the changing relations and gradual enlargement of the middle perforated space can be studied in whites alone from childhood to adult life. In all the apes and monkeys and in other mammals the middle perforated space is insignificant and the relative elevation of the petrous portions equals or exceeds that in the oranges.

There are present in a number of the skulls distinct styloids. The detail conditions in this respect are as follows:

*Styloids.*

| Male oranges. |               |              |          |               |              | Female oranges. |               |              |          |               |              |
|---------------|---------------|--------------|----------|---------------|--------------|-----------------|---------------|--------------|----------|---------------|--------------|
| Cat. No.      | Right length. | Left length. | Cat. No. | Right length. | Left length. | Cat. No.        | Right length. | Left length. | Cat. No. | Right length. | Left length. |
| 142183        | <i>mm.</i>    | <i>mm.</i>   | 142196   | <i>mm.</i>    | <i>mm.</i>   | 142171          | <i>mm.</i>    | <i>mm.</i>   | 142185   | <i>mm.</i>    | <i>mm.</i>   |
| 142195        | None.         | None.        | 142198   | Trace.        | Trace.       | 142201          | None.         | 2            | 142187   | None.         | 7            |
| 142188        | 6             | 1            | 142194   | Trace.        | Trace.       | 142202          | 4             | 2            | 142182   | 1             | 1            |
| 142200        | None.         | Trace.       | 142192   | 3             | 2            | 142193          | None.         | None.        | 142190   | 2             | ?            |
| 142197        | 2             | 3            | 142199   | 5             | 6            | 142170          | 1             | 1            | 142186   | 2             | 2            |
| 142180        | Trace.        | Trace.       | 142189   | 4             | 2            | 142169          | 5             | 6            | 142191   | 4             | 3            |
| 142181        | 3             | 4            |          |               |              |                 |               |              |          |               |              |

In nearly all of the specimens is seen a special spinous process, descending from the petrous bone, anterior to the carotid aperture, to the basilar process in front of the jugular foramen. In a few cases a similar process rises from the basilar, and where the two join (as, for instance, in No. 142183) there is formed a petro-basilar bridge and canal. In three instances (Nos. 142202, 142199, and 142189) there is an incomplete bridge in the usual place, and a second complete one or nearly so, a little more anteriorly. The part of the bridge projecting from the petrous bone is already well developed in the youngest skulls of both sexes.

The anterior condyloid foramen (which in man is usually single and transmits the twelfth cranial nerve with a meningeal branch of the ascending pharyngeal artery and its accompanying veins) was found in these, as in previously reported (Owen) oranges, to be almost generally double: or there is a single large mouth of two canals, both of fair size (though one, the more anterior, is mostly larger). In only three out of the twenty-six skulls were both the foramen and canal single, and in only one of these (No. 142199) they were so bilaterally. On the other hand, in four skulls (Nos. 142188, 142181, 142196, and 142201) there were on one side, always the left, three separate canals and foramina.



The posterior condyloid foramina, such as occur somewhat irregularly in man and each of which transmits a vein from the lateral sinus, are absent in the orangs. There are, near the usual location of these foramina in a number of the skulls very small single orifices, usually less than 1 millimeter in diameter, but these are only the openings of the canals of nutrient vessels. The posterior condyloid fossa, however, and the groove leading from it to the anterior condyloid depression, are invariably well represented, particularly so in the male skulls.

The articular surface of the condyles, often double in man, is single in all these specimens.

The foramen magnum differs greatly in size and shape, as will best be seen from the following figures:

*Measurements of foramen magnum.*

| Male orangs. |                  |                   | Female orangs. |                  |                   |
|--------------|------------------|-------------------|----------------|------------------|-------------------|
| Cat. No.     | Greatest length. | Greatest breadth. | Cat. No.       | Greatest length. | Greatest breadth. |
|              | <i>cm.</i>       | <i>cm.</i>        |                | <i>cm.</i>       | <i>cm.</i>        |
| 142183.....  | 3.3              | 2.2               | 142201.....    | 3.9              | 2.7               |
| 142188.....  | 2.9              | 2.4               | 142170.....    | 3.0              | 2.5               |
| 142181.....  | 3.3              | 2.8               | 142169.....    | 2.9              | 2.6               |
| 142198.....  | 3.5              | 2.7               | 142182.....    | 2.3              | 2.4               |
| 142194.....  | 4.1              | 3.2               | 142186.....    | 3.7              | 3.05              |
| 142189.....  | 3.8              | 2.7               |                |                  |                   |

It would be interesting to know the height of the different animals, to see what relation it bears to the size of the cord and foramen. The length of the aperture is often augmented by a broad notch in the posterior border, and this affects also the plane of the foramen. No such notch occurs normally in man. The axes of the orbits would pass, if prolonged, through the foramen magnum in all the specimens.

The point of insertion of the middle odontoid ligament on the center of that part of the basilar process which forms the anterior boundary of the foramen magnum is in most of the skulls very rough, and in some (Nos. 142181, 142189, 142169, 142185, and 142182) a process projects here into the lumen of the foramen. This process occurs also, though much less frequently, in man, and has sometimes erroneously been described as the third condyle.

None of the specimens under examination shows the oval medio-basilar ("pharyngeal") fossa, or any tubercles, such as can occasionally be found in man, on the anterior border of the foramen magnum; nor is there any trace of a true third condyle.

The base of the skull being damaged in a number of the specimens, and the calvarium being cut in others, it was possible to make a few observations also on some of the *ventral parts* of the crania.

The frontal bone shows in some of the specimens quite marked impressions of the brain convolutions, but in others it is nearly

smooth. The lower portion of the metopic crest is, in a large proportion of the skulls, absent or nearly so, the ethmoid depression is very deep, the crista galli insignificant, though not wholly wanting. The outline of a horizontal plane of the skull above the orbits is nicely ovoid, differing from that in man by greater convergence of the parietes toward the median line in front; in other words, the frontal region



FIG. 4.—SKULL OF MALE ORANG (Cat. No. 142198 U.S.N.M.). *a*, ARCH IN THE DORSUM SELLE; *f* COMPLETE FENESTRUM ABOUT THE GASSERIAN GANGLION.

of the orang brain is more pointed than in man. In the gibbon and lower primates this condition is still more accentuated.

The spinous foramen is absent; it is merged with the foramen ovale, which is spacious.

The middle and posterior clinoids, and in some cases the anterior ones also, are united by a bridge which completes a large pituitary foramen. In six cases only is this union wanting and in two others it is on one side incomplete. The dorsum sellæ is in seventeen skulls (11

males, 6 females) an arch over a large foramen (see fig. 4*a*), in six (1 male, 5 females) it consists only of two diverging laminae with wide mesial separation, and in one case (female, No. 142201) there are only traces of even these laminae.

The lateral borders of the dorsum sellae or its components, articulate at their base, in many of the specimens, with a process from the point of the petrous part over a quite spacious canal for the inferior petrosal sinus; and a little farther laterad the free superior border of the petrous bone shows a marked oval depression for the Gasserian ganglion. This hollow is more pronounced than in man; in some of the speci-



FIG. 5.—SKULL OF FEMALE ORANG (Cat. No. 142170 U.S.N.M.), SHOWING A DIMINUTION IN SIZE OF THE MOLARS FROM THE FIRST BACKWARDS.

mens projecting spiculae from the superior border of the petrous bone convert it into an incomplete foramen; and in one case (No. 142198) there is on the right side a union of these processes, from which results a complete spacious bony fenestrum (fig. 4*f'*). This feature, so far as the writer could find, has not been reported previously either in apes or man.

*The teeth.*—Orang teeth in general have been studied thoroughly by Selenka,<sup>a</sup> and there will be added in this place only a few particulars.

The male teeth are all larger than the corresponding ones of the

<sup>a</sup> Menschenaffen, p. 57 et seq.



females and the latter also approach more the human form. In some of the females (as, for instance, No. 142170) the upper molars diminish very perceptibly from the first to the third and are also not far from

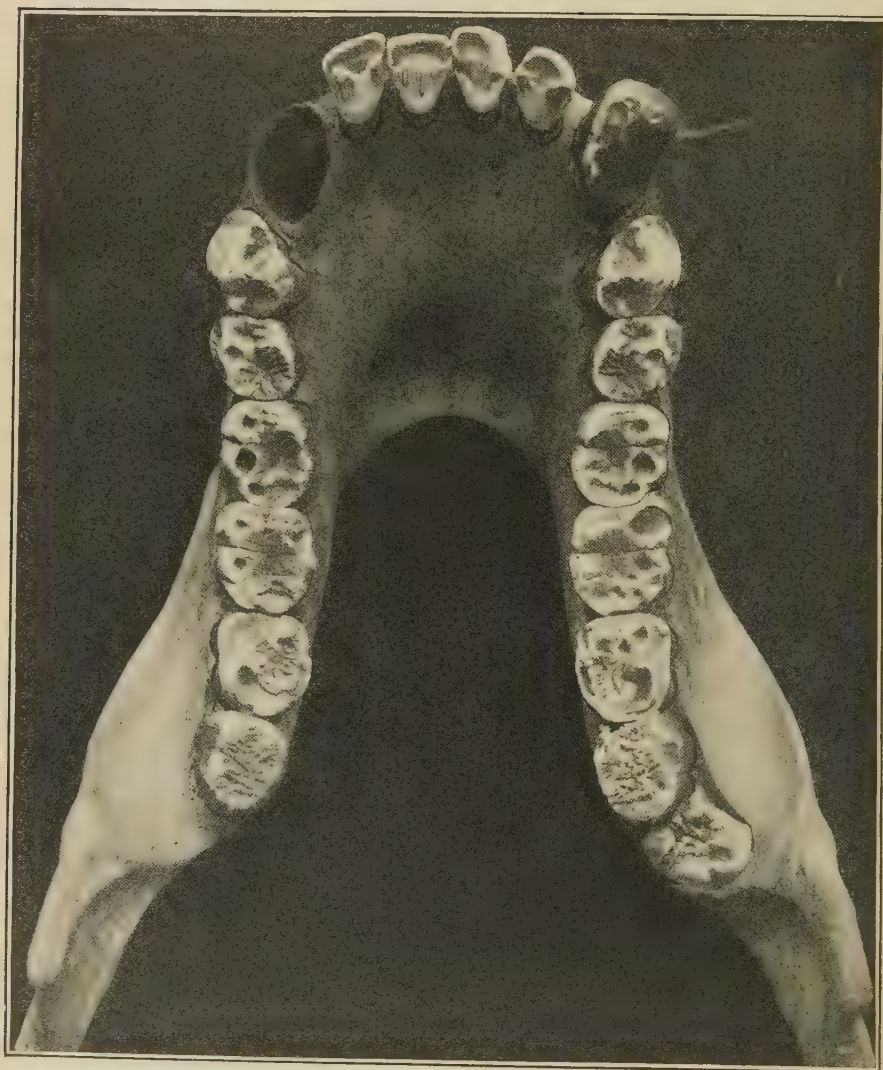


FIG. 6.—MANDIBLE OF MALE ORANG (Cat. No. 142199 U.S.N.M.), SHOWING FOUR TRUE MOLARS ON THE LEFT AND FIVE ON THE RIGHT SIDE.

human teeth in size (maximum length of the three superior molars 3.25 cm., mean in two average men 3.2 cm.; maximum breadth 1.35 cm., mean in two men 1.25 cm.) (fig. 5).<sup>a</sup>

In a number of the specimens are found supernumerary teeth, while

<sup>a</sup> See also fig. 13, in Gaudry, *Sur la similitude des dents de l'homme et de quelques animaux*, *L'Anthropologie* 1901, p. 93.



in one the right third lower molar seems to be permanently wanting. Among the 12 males and 10 females with full second dentition the conditions are as follows:

*Dentition.*

|                                  | Male.  |       |        |       | Female. |       |        |       |
|----------------------------------|--------|-------|--------|-------|---------|-------|--------|-------|
|                                  | Above. |       | Below. |       | Above.  |       | Below. |       |
|                                  | Right. | Left. | Right. | Left. | Right.  | Left. | Right. | Left. |
| Normal dentition (2-1-2-3) ..... | 10     | 11    | 9      | 9     | 10      | 10    | 8      | 10    |
| Two molars only .....            |        |       | a1     |       |         |       |        |       |
| Four molars .....                | 2      |       | 1      | 3     |         |       | b2     |       |
| Five molars .....                |        |       | c1     |       |         |       |        |       |
| A supernumerary canine .....     |        | d1    |        |       |         |       |        |       |

<sup>a</sup>No. 142181.

<sup>b</sup>No. 142199 (upper right); No. 142195 (upper left); No. 142180 (lower both sides); No. 142198 (lower left); No. 142199 (lower left); No. 142170 (lower right); No. 142190 (lower right).

<sup>c</sup>No. 142199.

<sup>d</sup>No. 142181.

The fifth molar in No. 142199, a fully adult male, is of large size, but only about half erupted (fig. 6), so that it shows at the same time an example of late dentition. The supernumerary tooth in No. 142181 (fig. 7) is situated ventrally and in apposition to the regular canine, touching also the lateral incisor. It is not as large as the canine proper, but is decidedly broader and higher than any of the incisors. The left side of the lower jaw, which contains this tooth, is longer than the right, which renders the front of the bone asymmetric (the right side of this jaw presents a crowding of the premolars and an absence of the third molar, though there is not a lack of space for this last). Selenka found <sup>a</sup> in his collection dental anomalies of the following varieties and proportions:

*Dental anomalies.*

|                                                                   | 84 grown males. | 110 grown females. |
|-------------------------------------------------------------------|-----------------|--------------------|
| Fourth molar below on right side in .....                         | 2               | 1                  |
| Fourth molar below on left side in .....                          | 3               | 2                  |
| Fourth molar below on both sides in .....                         | 4               | 6                  |
| Fourth molar above on right side in .....                         | 0               | 2                  |
| Fourth molar above on left side in .....                          | 4               | 1                  |
| Fourth molar above on both sides in .....                         | 2               | 1                  |
| Fourth molar above on left and below on right side in .....       | 0               | 1                  |
| Fourth molar above on left and below on both sides in .....       | 0               | 2                  |
| Fourth molar above on right and below on both sides in .....      | 2               | 0                  |
| Fourth molar above on both sides and below on left side in .....  | 1               | 0                  |
| Fourth molar above and below on both sides in .....               | 2               | 1                  |
| Five molars on each side above with 4 on each side below in ..... | 1               | 0                  |
| Total of cases .....                                              | 21              | 17                 |

Besides the above, Selenka observed three supernumerary premolars (two above in one skull, one below), and one supernumerary incisor (details not given). Extra molars, it is seen from both series, predominate in males and in the lower jaw, where the teeth in general show a greater development. In No. 142198 of Doctor Abbott's series the fourth lower molar is rudimentary (fig. 8).

The study of orang crania as a whole impresses one with the high degree of individual variation and with the rôle played by the muscles and teeth in modifying various parts. As both of these agencies are mainly connected with the kind of food, the plausible suggestion forces itself upon the mind that a prolonged change, lasting through a number of generations, to food requiring much less mastication should

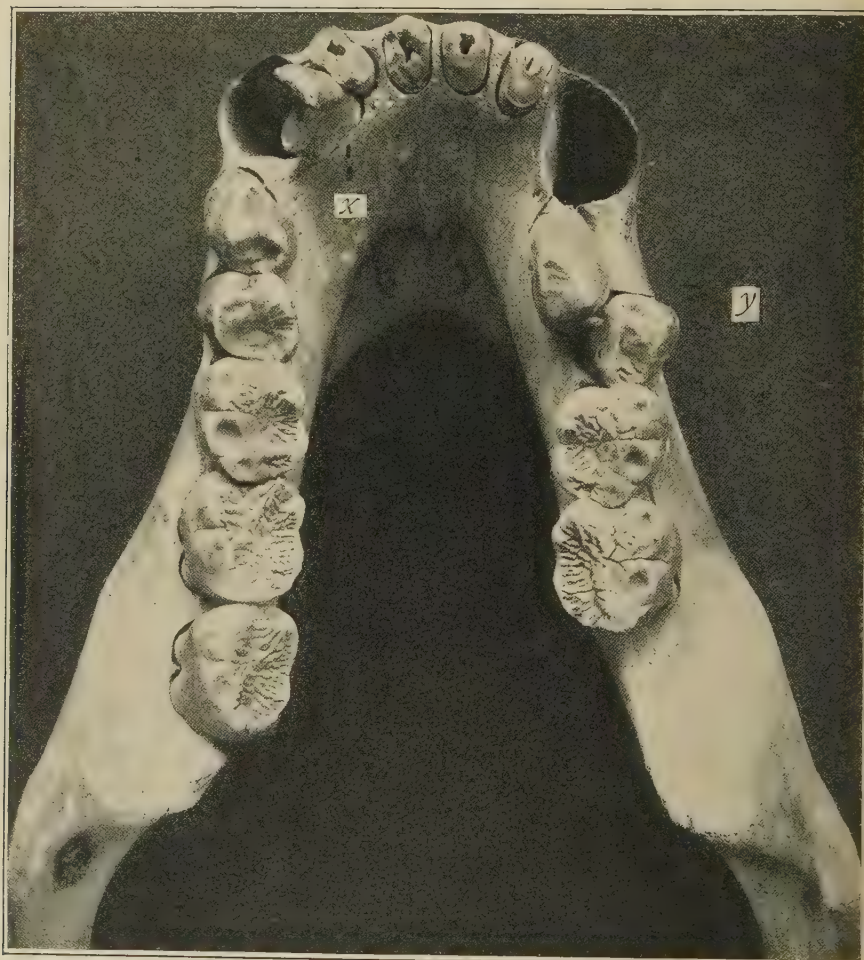


FIG. 7.—MANDIBLE OF ADULT MALE ORANG (Cat. No. 142181 U. S. N. M.). *x*, A SUPERNUMERARY TOOTH; *y*, IRREGULARITY OF THE PREMOLARS. THE RIGHT RAMUS EXHIBITS ONLY TWO MOLARS.

greatly modify the whole orang skull. It should also bring it nearer to the human type, for the features by which the orang cranium differs most from the human are with few exceptions exactly those produced by greater teeth and muscles of mastication.

As this paper goes to print word is received from Doctor Abbott of a shipment to the National Museum of further material, consisting of eighteen crania and skeletons of orangs from Sumatra; these

ought to prove of great interest in connection with the Borneo material here described.

An endeavor has been made by the writer to collect the bibliography of writings relative to or dealing with orang craniology. This proved



FIG. 8.—MANDIBLE OF FEMALE ORANG (Cat. No. 142198 U.S.N.M.), SHOWING A RUDIMENTARY FOURTH MOLAR ON THE LEFT.

to be an arduous task, though the number of larger contributions to the subject is limited. The following pages contain all the works that could be personally examined, and there were only a few obscure titles where this was not possible:

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For other notes on Orang crania see general works on zoology and comparative anatomy.

## DESCRIPTION OF A NEW SPECIES OF GREAT ANT-EATER FROM CENTRAL AMERICA.

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The restricted genus *Myrmecophaga* has long been considered monotypic, the single species *tridactyla* being accorded a range from Guatemala to Brazil. An examination of material in the collection of the United States National Museum as well as in the collections of the Museum of Comparative Zoölogy, Cambridge; American Museum of Natural History, New York; and the Academy of Natural Sciences, Philadelphia, shows that constant specific differences exist between skulls of individuals from South America and those of individuals from Central America. The material now available is insufficient for determining whether these internal differences are correlated with external differences.

I am indebted to Mr. Outram Bangs, Cambridge, Massachusetts, Dr. J. A. Allen, New York City; and Messrs. Witmer Stone and James A. G. Rehn, Philadelphia, Pennsylvania, for the loan of specimens from the collections under their care, for use in connection with the preparation of this paper.

### GENERIC NAMES OF THE GREAT ANT-EATERS.

*Myrmecophaga*.—First used by Linnæus in 1758<sup>a</sup> with three species, namely, *didactyla* Linnæus, from South America (type of *Cyclopes* Gray 1821), *tridactyla* Linnæus (type of the genus *Myrmecophaga*, by elimination) and *tetradactyla* Linnæus (type of *Uroleptes* Wagler 1830.)<sup>b</sup>

<sup>a</sup>Systema Naturæ, 10th ed., I, p. 35.

<sup>b</sup>For a discussion of the term *Myrmecophaga* see Rehn, American Naturalist, XXXIV, 1900, pp. 575, 576; Thomas, idem., XXXV, 1901, pp. 143, 144; and Allen, Proc. Biol. Soc. Washington, XIV, 1901, pp. 91, 92; whence it is evident that *Myrmecophaga* is the proper generic designation of the Great Ant-eaters.

*Mammyrmecophagus*.—Herrera, 1899, "Sinonimia vulgar y científica de los principales Vertebrados Mexicanos," proposed as a modification of Linnæus' term *Myrmecophaga*.

*Falcifer*.—Rehn, 1900;<sup>a</sup> type, *Myrmecophaga jubata* Linnæus from Brazil; proposed as a name for the Great Ant-eater under the erroneous belief that the type of *Myrmecophaga* was *tetradactyla* and not *tridactyla*.<sup>b</sup>

#### SPECIFIC NAMES OF THE GREAT ANT-EATERS.

*Tridactyla* Linnæus,<sup>c</sup> "Habitat in America meridionali." Type of the genus *Myrmecophaga* Linnæus by elimination.<sup>d</sup>

*Jubata* Linnæus,<sup>e</sup> "Habitat in Brasilia, Cap. b. spei." Type of *Falcifer* Rehn (see above). It is antedated by *tridactyla* as a specific term for the Brazilian Great Ant-eater.

As no name is available for the Great Ant-eater of Central America, it may be known as

#### MYRMECOPHAGA CENTRALIS, new species.

*Type*.—Young adult skull, Cat. No. 15963 (no skin), U.S.N.M.; collected at Pacuare, Costa Rica, June, 1876, by José C. Zeledon. Original No. 86.

*Diagnostic characters*.—Like *Myrmecophaga tridactyla*, but median anterior extension of frontal bones not produced much farther forward than lateral anterior extensions of same bones (Plate XIV, figs. 1 and 2); most anterior point of squamosal extending forward decidedly less than half way between the middle of the root of the zygomatic process and the most anterior point of the alisphenoid (see Plate XIV, fig. 3).

In *Myrmecophaga centralis* the antero-inferior angle of the parietal extends downward and inward so that it appears on the inferior surface of the skull for a distance of 5 to 10 mm., the inferior portion being separated from the lateral portion by a more or less evident ridge, while in *M. tridactyla* scarcely any of the antero-inferior angle of the parietal appears on the under side of the skull. Owing to the forward extension of the squamosal in the Brazilian Ant-eater the lateral portion of the alisphenoid is narrower behind than in front, while in the Central American animal, owing to the downward extension of the antero-inferior angle of the parietal, the lateral portion of the alisphenoid is narrower in front than behind. (See Plate XIV, figs. 3 and 4.) In *M. tridactyla* the most anterior point of the squamosal is about midway between the most anterior point of the alisphenoid and

<sup>a</sup> American Naturalist, XXXIV, 1900, p. 576.

<sup>b</sup> Rehn, Thomas, and Allen. For references see foot note on p. 569.

<sup>c</sup> Systema Naturæ, 10th ed., I, 1758, p. 35.

<sup>d</sup> Thomas, American Naturalist, XXXV, 1901, p. 143. Linnæus' first reference, "Tamandua-guacu, Marcgr. bras 225," permits the type locality to be fixed as Brazil.

<sup>e</sup> Systema Naturæ, 12th ed., I, 1766, p. 52.



the middle of the root of the zygomatic process, in *M. centralis* the same point is situated much more posteriorly.

The differences in size between the two specimens figured is due to age or to individual variation, as some Central American skulls are as large as the South American skull figured, and some South American skulls are as small as the Costa Rican skull figured. The interorbital constriction seen in the Brazilian skull is probably individual.

Considerable variation is seen in various parts of the skulls of the Great Ant-eaters, especially in the region of the lachrymal bone, the antero-posterior diameter of which is relatively short in all the Central American skulls, while in some of the South American skulls it is much elongated, and in others it is short. It is possible that when large series of specimens are obtained from definite localities, other forms of the Great Ant-eater may be recognized.

#### SKULLS EXAMINED.

##### *Myrmecophaga centralis*

Cat. No. 15963. U.S.N.M. Pacuare, Costa Rica, Type.

Cat. No. 14107. U.S.N.M. Talamanca, Costa Rica.

Cat. No. 14155. U.S.N.M. Talamanca, Costa Rica.

Cat. No. 10095. Mus. Comp. Zool. (Bangs coll.), Divala, Panama.

##### *Myrmecophaga tridactyla*.<sup>a</sup>

Cat. No. 13004. U.S.N.M. Surinam.

Cat. No. 143131. U.S.N.M. Surinam.

Cat. No. 49597. U.S.N.M. San Sebastian, Marajo, Brazil.

Cat. No. 22986. U.S.N.M. (mounted skeleton). Locality unknown.

Cat. No. 20753. U.S.N.M. (mounted skeleton). Locality unknown.

Cat. No. 8414. Mus. Comp. Zool. (Bangs coll.). Dibulla, Colombia.

Cat. No. 194. Amer. Mus. Nat. Hist. Brazil.

Cat. No. 16137. Amer. Mus. Nat. Hist. Ciudad Bolivar, Venezuela.

Cat. No. 16924. Amer. Mus. Nat. Hist. Maripa, Venezuela.

Cat. No. 4634. Acad. Nat. Sci. Phila. Brazil.

Cat. No. 4639. Acad. Nat. Sci. Phila. Brazil.

#### EXPLANATION OF PLATE XIV.

All figures about  $\frac{2}{3}$  natural size.

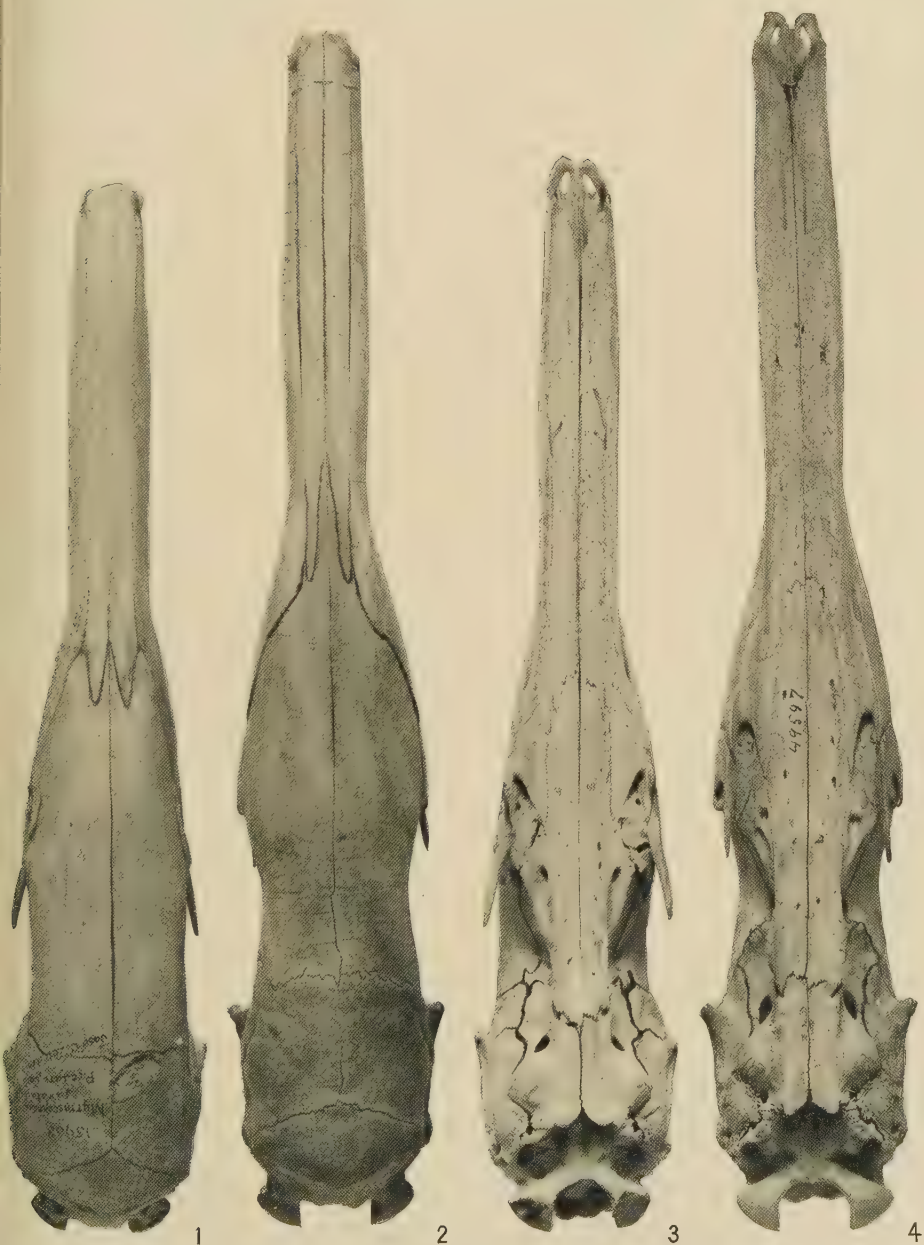
Figs. 1 and 3. *Myrmecophaga centralis*, No. 15963, Type from Pacuare, Costa Rica.

Figs. 2 and 4. *Myrmecophaga tridactyla*, No. 49597, from San Sebastian, Marajo, Brazil.

In both skulls the fronto-nasal sutures, and those about the squamosal and alisphenoid have been intensified by the use of pigment before the photographs were taken.

<sup>a</sup>The skull represented in Flower's Osteology of the Mammalia, 1885, p. 230, fig. 69, belongs to the South American species. The locality is not given. Specimen No. 115 from Surinam, represented in Elliot's Land and Sea Mammals of Middle America and West Indies, 1904, p. 29, fig. 8, as judged from the illustration, also belongs to this species.





SKULLS OF GREAT ANT-EATERS.

FOR EXPLANATION OF PLATE SEE PAGE 571.





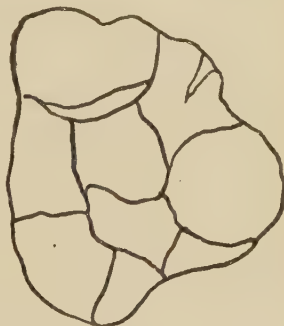
# NOTE ON AN OCCURRENCE OF GRAPHITIC IRON IN A METEORITE.

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During the course of some investigations as to the relation of structure to composition in meteoric irons, at present being carried on by me, a black concretion was observed in a sample of the Canyon Diablo meteorite. This concretion was of such a size that it was readily broken out in a nearly perfect condition.

On cutting it, in order to make a metallographic examination, the mass was found to be a septarian nodule (see figure), the septa consisting of the native metals which metallographically did not differ from that of the mass of the iron. The interseptal portions consisted of a very fine-grained, distinctly crystalline graphitic carbon, and amorphous carbon, which could be separated from each other in part by floating. Intimately mixed with the two kinds of carbon is a very fine granular or scaly troilite. There is also present a lustrous metallic, dark steel-gray substance occurring in irregular angular masses varying in size from minute grains to one weighing 110 milligrams. This material was at first taken for graphite in that it closely resembled that mineral. It was, however, strongly magnetic, thus affording a ready method for its separation.



PLAN OF SEPTARIAN NODULE.  
(Twice natural size.)

The composition of the material thus isolated is as follows:

|         |                  |
|---------|------------------|
| Fe..... | 88.84            |
| Ni..... | 4.00             |
| Co..... | ( <sup>a</sup> ) |
| Si..... | 2.00             |
| C.....  | 4.35             |
| P.....  | 0.87             |
|         | <hr/>            |
|         | 100.06           |

Specific gravity, 6.910.

<sup>a</sup> Present, but not weighable.

Weinschenk <sup>a</sup> has described a carbide of iron, cohenite, having the following properties: Hardness 5.5-6, specific gravity 6.977, luster metallic, color tin-white, becoming bronze yellow on exposure. Occurring in crystals, probably isometric, having the following composition: Fe, 89.88; Ni (Co), 3.71; C, 6.41; Sn, Cu, trace.

The graphitic iron here described differs from cohenite, in that it is soft enough to leave a mark on white paper; does not occur in crystals belonging to the isometric system but in angular foliated masses. Its color is dark steel gray, while cohenite is tin-white.

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<sup>a</sup> Ann. Mus. Wien., IV, p. 94, 1889.

## MAMMALS OF BANKA, MENDANAU, AND BILLITON ISLANDS, BETWEEN SUMATRA AND BORNEO.

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This paper is based on 274 specimens of mammals collected on the islands of Banka and Billiton and on the little island of Mendanau lying off the west coast of Billiton (see map, page 577), by Dr. W. L. Abbott, between January 20, 1904, and August 14, 1904, and presented to the United States National Museum. No general account, so far as I am aware, has appeared concerning the mammal fauna of Banka. Jentink<sup>a</sup> has twice published lists of the mammals of Billiton. Many specimens in the collection of the Leyden Museum are recorded from Banka by Schlegel, by Jentink,<sup>b</sup> and by Müller.<sup>c</sup>

Recently Willink<sup>d</sup> has published a list of the mammals of the Dutch East Indies, showing the species known from Banka and Billiton as well as from many other islands.

Banka, also spelled Bangka, the larger of the two islands, is just off the coast of Sumatra from which it is separated by a channel less than 10 miles wide in places and varying in depth between 10 and 19 fathoms. The average width of the island is about 50 miles and its length, which extends from northwest to southeast, is about 150 miles. There are several hills on it, the highest of which is in the northern part and is recorded as being 2,296 feet in altitude. Doctor Abbott's remarks on his collecting stations are given beyond.

Billiton, measuring about 50 miles square, lies nearly 50 miles to the east of the southern extremity of Banka. The highest hill on it is said to be 1,673 feet in altitude. The waters between Banka and Billiton have a depth ranging from 19 to 29 fathoms. A number of small islands occupy this channel. Doctor Abbott collected only on one of them, Mendanau, about 4 miles to the west of Billiton. Billi-

<sup>a</sup> Notes, Leyden Museum, XII, 1890, pp. 149-154; and XIII, 1891, pp. 207-209.

<sup>b</sup> Catalogue Systematique des Mammifères. Catalogue Osteologique des Mammifères, and Simiae. Mus. d'Hist. Nat. Pays-Bas.

<sup>c</sup> Verhandel. Natuur. Geschied. Nederl. Over. Bezitt. Zool., 1839-44.

<sup>d</sup> Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, 10th ser., Pt. 9, pp. 153-345.

ton is separated from the west coast of Borneo by the wide Karimata Strait (about 125 miles), which has an average depth of about 25 fathoms. The notes on Doctor Abbott's collecting stations are given beyond.

From the geographical situation of these two islands it would be expected that their mammal faunas would be similar to the fauna of Sumatra; but from a study of Doctor Abbott's collections it becomes apparent that the zoological relations of these two islands, so far as mammals are concerned, are with distant Borneo, and not with near by Sumatra. The relationship between themselves is rather close.

### SYSTEMATIC LIST OF SPECIES.

#### TRAGULUS BANCANUS, new species.

1887. *Tragulus napu* JENTINK, Mus. d'Hist. Nat. de Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 156.

1891: *Tragulus napu* JENTINK, Notes Leyden Museum, XIII, 1891, p. 209.

1905. *Tragulus napu* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 198.

*Type*.—Adult female, skin and skull, Cat. No. 124714, U.S.N.M. Collected at Tanjong Tedong, island of Banka, east of Sumatra, May 31, 1904, by Dr. W. L. Abbott. Original number 3283.

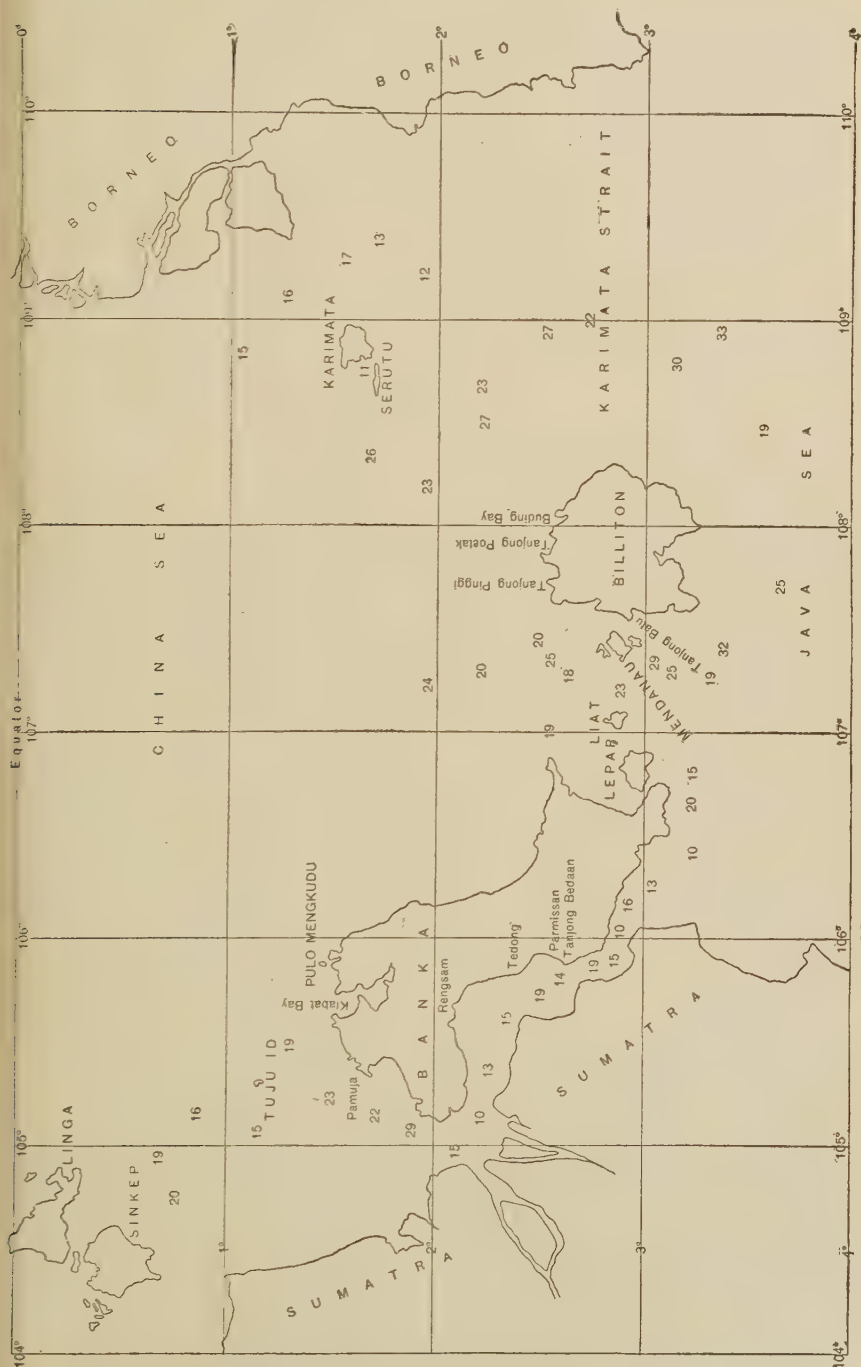
*Diagnostic characters*.—Very closely related to *Tragulus napu* of Sumatra, but brighter in color; skull not quite so large.

*Color*.—Type: General color above tawny-ochraceous (in *T. napu* it is ochraceous), but everywhere very largely obscured by the conspicuous black tips to the hairs. On the sides the tawny-ochraceous is replaced by a dull ochraceous or ochraceous buff. Top and sides of the head and neck similar in color to back, but less obscured by black tips to the hairs, except along the indistinct nape stripe. Underparts white, except a short narrow suffusion of the color of the sides just posterior to the chest. Throat pattern normal, the hairs of the dark stripes a dull tawny-ochraceous, but heavily tipped with black so that but little of the former color is seen. Hairs of collar dull ochraceous tipped with black, both colors equally prominent. Forearm similar in color to the back on outer side, but black tips to hairs less conspicuous and scarcely noticeable or absent about the wrist. Inner side of foreleg white. Hind legs similar in color to the sides, but black less conspicuous. Just above heel, at situation of gland, a rather conspicuous spot of tawny-ochraceous, in contrast to the general ochraceous color of the legs. Tail like back above, but black not so conspicuous; white below and at tip.

*Skull and teeth*.—There are no characters by which the skull of *Tragulus bancanus* can be distinguished from that of *T. napu*.

*Measurements*.—See table, page 581.





MAP OF BANKA, MENDANAU, AND BILLITON.

*Specimens examined*.—Five females and 1 male, all from the island of Banka, as follows: Klabat Bay, 3; Tanjong Bedaan, 1; Tanjong Tedong, 1; Tanjong Rengsam, 1.

*Remarks*.—The series of *Tragulus bancanus* is very uniform in color. Two of the specimens have the black tips of the hairs worn off, and are consequently lighter than the others. It is most closely related to *T. napu*, from which it differs in its brighter color. It differs in the same respect from *T. canescens* of the Malay Peninsula, as well as in its slightly smaller size.

**TRAGULUS BILLITONUS, new species.**

1891. *Tragulus napu*, melanistic variety, JENTINK, Notes Leyden Museum, XIII, 1891, p. 209.

1905. *Tragulus napu* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 198.

*Type*.—Adult male, skin and skull, Cat. No. 124929, U.S.N.M., collected at Tanjong Batu, Billiton Island, east of Sumatra, July 20, 1904, by Dr. W. L. Abbott. Original number 3524.

*Diagnostic characters*.—A member of the *Tragulus napu* group, related to *T. pretiellus* and *T. umbrinus*, but darker and duller in color than the former, lacking the bright color along the sides of the body, neck, and head, and not quite so dark as the latter, and with a well-defined nape stripe instead of the diffused dark color of the neck in *umbrinus*.

*Color*. Type: General color of hairs above tawny-ochraceous, but heavily tipped with black, the latter color predominating in the general effect. On the sides the tawny-ochraceous is replaced by buff and the black tips to the hairs are less conspicuous. Top and sides of head and neck similar in color to the back, but black tips to the hairs less conspicuous except along the rather narrow nape stripe. Under parts white in region of chest and groin, but the middle of the belly, for an extent of 150 mm., is suffused with ochraceous buff. Throat pattern normal, the hairs a somewhat duller tawny-ochraceous than the back and heavily tipped with black so that the latter color predominates. Hairs of collar lighter in color, approaching ochraceous buff, with black tips, both colors equally prominent. Foreleg generally tawny-ochraceous, without much admixture of black. A narrow, white line extends on the inner side of the leg from the wrist upward to meet the white of the chest. Hind leg similar to foreleg in color, but generally darker and with more white on the inner side. Upper surface of tail similar to back, but black of hairs not so conspicuous. Tip and underside of tail white. Ears, orbital ring, preorbital stripe, nose and lips blackish.

*Skull and teeth*.—Apparently there are no characters by which to distinguish the skull of *Tragulus billitonius* from that of related species.

*Measurements*.—See page 581.

*Specimens examined*.—Eight males, two females, all from the island of Billiton; Tanjong Batu, six; Bukit Menguru, three; Tanjong Poetak, one.

*Remarks*.—The series is fairly uniform in color. The underparts are mainly whitish in most of the specimens; the type has the most extensive suffusion. Many of the specimens have a narrow, dark line extending in the median line of the chest, sometimes from the collar to the middle of the belly, but usually shorter. Two of the specimens, Cat. Nos. 124930 and 125003, U.S.N.M., are somewhat lighter and grayer than the average of the series; Cat. No. 124930, U.S.N.M., is further abnormal or partly albinistic in having a thick scattering of gray hairs on the top of the neck and shoulders and a few scattered whitish patches over the surface of the body.

**TRAGULUS LUTEICOLLIS, new species.**

1891. *Tragulus kanchil* JENTINK; Notes Leyden Museum, XIII, 1891, p. 209.

*Type*.—Adult male, skin and skull, Cat. No. 124733, U.S.N.M., collected at Tanjong Bedaan, island of Banka, east of Sumatra, June 12, 1904, by Dr. W. L. Abbott. Original number 3311.

*Diagnostic characters*.—Very closely related to *Tragulus kanchil* of Sumatra, from which it differs in a generally duller color very noticeable on side of head and neck, and less black on the upper parts. It is slightly larger than *kanchil*, as may be seen by reference to table of measurements on page 581.

*Color*.—Type: General color of hairs above a dull ochraceous-buff or orange-buff, tipped with black; the two colors about equally prominent except along the well-marked nape stripe and crown of head, which are nearly entirely black. On the sides of the body the black is less in evidence than on the back, and the ochraceous-buff is paler. Underparts generally white, a buffy suffusion in axillæ; a suffused patch, 18 cm. long, of similar color in the ventral line, about 1 cm. wide anteriorly where it is of the same color as the collar and widening out posteriorly to 4 cm. where it is a dull ochraceous-buff unmixed with blackish tips of the hairs. Throat pattern normal, similar in color to the middle of the sides; less black in the collar, so that it is nearly a clear dull ochraceous-buff. Forelegs almost a pure ochraceous, slightly sprinkled with black in the upper portion. A narrow white stripe on inner side of leg. Hind leg generally similar to color of middle of sides, but a little brighter; inner side white. Upper surface of the tail like back; tip and underside white. Sides of head and neck a dull orange or ochraceous-buff, more buffy anteriorly, grizzled by the blackish tips to the hairs. Ears blackish.

Five of the specimens of *Tragulus luteicollis* are considerably lighter in color along the back and sides than is the type specimen and rest of

the series, due to the wearing off of the black tips to the hairs. The general ochraceous buff is also lighter and duller in color in these specimens.

*Skull and teeth.*—There are no characters by which the skull of *Tragulus luteicollis* can be distinguished from that of *T. kanchil*. A series of measurements (see table, page 581) shows the skull to be slightly larger in the average.

*Measurements.*—See table, page 581.

*Specimens examined.*—Ten females and 8 males; 11 fully adult, 3 nearly adult and 4 young; all from the island of Banka; 14 from Tanjong Bedaan, 1 from Tanjong Tedong, 1 from Tanjong Rengsam, and 2 from Parmassan.

*Remarks.*—*Tragulus luteicollis* is closely related to *T. kanchil*, but is readily distinguished by the more yellow color on the sides of the neck, and generally darker back. From *T. carinata* it differs in the smaller size and more yellow neck. From *T. rarus* it differs in being generally less ruddy and bright, especially along the sides of the body and neck.





MUNTIACUS<sup>a</sup> BANCANUS, new species.

1891. *Cervulus muntjac* JENTINK, Notes Leyden Museum, XIII, 1891, p. 209 (Billiton specimens).

1905. *Cervulus muntjac* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 189. (Banka and Billiton.)

*Type*.—Skin and skull of adult female, Cat. No. 124726, U.S.N.M., collected at Tanjong Bedaan, island of Banka, east of Sumatra, June 7, 1904, by Dr. W. L. Abbott. Original number 3296.

*Diagnostic characters*.—Externally similar to *Muntiacus moschatus* (Blainville) of Sumatra, but decidedly smaller. Skull similar to that of *Muntiacus pleiharicus* (Kohlbrugge) of Borneo, but interpterygoid space narrower and lachrymo-maxillary suture distinctly longer.

*Color*.—General color of upper parts of body and tail something between Ridgway's hazel and ferruginous, deepest along the middle line, becoming duller and lighter along the sides and flanks and thighs. Beginning at the ears and extending over the shoulder the ferruginous-hazel color is overwashed with blackish, caused by the black subapical rings of the hairs in that region. Crown of head, bright ferruginous-hazel. A black line extends from near the base of ear downward and inward to meet the corresponding line of the other side in the middle line at about the level of the opening of the lachrymal gland. Muzzle indefinitely brownish. Sides of head and neck similar to sides of body. Under parts from axillæ to inguinal region similar to sides of body, an indistinct brownish mid-ventral line. Chin, upper throat (lower throat similar to sides of neck), axillæ, narrow band across chest, inside of upper foreleg, inguinal region, inner side of thighs, and under surface of tail white. Fore and hind legs washed with dull brownish. A small lighter colored area just above hoofs corresponds to the conspicuous white spots seen in the same location in the Indian Muntjacs. External surface of ears blackish; internally, scantily haired, buffy.

*Skull and teeth*.—Very similar to those in *Muntiacus pleiharicus* from Borneo. If the inferior-external boundaries of the interpterygoid space be prolonged backward they will be found to pass internal to the paramastoid process in the Banka Muntjac, while in the Bornean Muntjac they pass much external to this process. In *Muntiacus bancanus* the lachrymo-maxillary suture measures about 20 mm., while in *M. pleiharicus* it is about 15 mm. The posterior root of the zygomatic process is sharply marked off from the glenoid fossa by a conspicuous rounded ridge in the Muntjac from Borneo, while in the one from Banka the posterior root of the zygomatic process gradually merges into the rest of the process. This difference is rather hard to

<sup>a</sup> The well-known name *Cervulus* Blainville, 1816, is antedated by *Muntiacus* Rafinesque, 1815.

describe, but is easily appreciated in viewing the two forms. In the fronto-nasal region and just posteriorly, on the upper surface of the skull, is found a well-marked concavity in the Bornean animal, which is lacking in the one from Banka. The mandibular symphysis measures on its upper aspect about 25 mm. in *M. pleiharicus* and about 20 mm. in *M. bancanus*. The antero-posterior diameter of the first lower premolar is greater in the Bornean animal than in the one from Banka; the same differences are found in the first upper premolars.

*Measurements.*—For measurements of Banka Muntjacs and specimens from Sumatra, Borneo, and the Malay Peninsula see table, page 584.

*Specimens examined.*—Two adult females, skins and skulls, Cat. No. 124726, U.S.N.M., the type from Tanjong Bedaan, and Cat. No. 124752, U.S.N.M., from Parmassan, the frontlets and antlers of five males from Parmassan and one frontlet (with skin dried on) and antlers from Buding Kampong, Billiton.

*Remarks.*—*Muntiacus bancanus* is at once distinguished by its smaller size from *M. moschatus* of Sumatra and from *M. grandicornis* of the Malay Peninsula, from *M. pleiharicus*<sup>a</sup> of Borneo, it is readily separated by its brighter color, absence of a dorsal stripe, and by well-defined cranial characters. The single specimen from Billiton consisting only of a pair of antlers, the frontlet and its dried skin is very close to the Bankan Muntjac. The colors in the frontlet are bright and well marked, and in size it agrees with the Banka specimens.

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<sup>a</sup> I have referred three specimens of Bornean Muntjacs in the United States National Museum to this species. Two skins of females agree fairly well as to color with the original description of *M. pleiharicus* and possess a dorsal stripe though it is not well marked and the antlers and frontlet of a male are about the same in size as the original figure of *M. pleiharicus* (Kohlbrugge, *Natuurkundig Tijdschrift voor Nederlandsch* 9th ser., IV, 1896, p. 192, plate facing p. 260.) I do not believe that much weight can be placed on the shape of the antlers of *M. pleiharicus* for an adult male from Tenasserin, Cat. No. 111969 U.S.N.M., has antlers and pedicles very similar to those figured by Kohlbrugge.

Measurements of specimens of *Muntjacs* from Banka, Borneo, Sumatra, and Malay Peninsula.

| Name.                           | Locality.                      | Number.               | Sex.      | Age.                 | Head and body. | Tail vertebrae. | Hind foot. |
|---------------------------------|--------------------------------|-----------------------|-----------|----------------------|----------------|-----------------|------------|
| <i>M. bancanus</i> , type ..... | Banka Tanjong Be-<br>daan.     | 124726                | Female... | Adult...             | mm. 920        | mm. 120         | mm. a 235  |
| Do.....                         | Banka, Parmassan...            | 124752                | do .....  | do .....             | 970            | 110             | a 250      |
| <i>M. pleiharicus</i> .....     | Borneo, near Sanda<br>kan.     | $\frac{34883}{18181}$ | do .....  | do .....             | a 850          | a 125           | a 255      |
| Do.....                         | Borneo, Kinabatangan<br>River. | $\frac{34902}{18181}$ | do .....  | do .....             | c 930          | c 145           | c 255      |
| <i>M. moschatus</i> .....       | Sumatra, Tarussan<br>Bay.      | 141030                | Male..... | Young <sup>d</sup> . | 1,020          | 170             | a 300      |
| <i>M. grandicornis</i> .....    | Tenasserim, Tanjong<br>Badak.  | 104089                | Female... | Adult...             | 1,029          | 190             | a 290      |
| Do.....                         | do.....                        | 104088                | Male..... | Old .....            | 1,067          | 203             | a 305      |

| Name.                           | Locality.                      | Ear from crown. | Weight in kilo-grams. | Weight in pounds. | Greatest length of skull. | Basal length. | Zygomatic width. | Maxillary tooth row (alveoli). | Mandibular tooth row (alveoli). |
|---------------------------------|--------------------------------|-----------------|-----------------------|-------------------|---------------------------|---------------|------------------|--------------------------------|---------------------------------|
| <i>M. bancanus</i> , type ..... | Banka Tanjong Be-<br>daan.     | mm. a 66        | kgs. 14               | lbs. 31           | mm. 186                   | mm. 163.5     | mm. 74.5         | mm. 53                         | mm. 62                          |
| Do.....                         | Banka, Parmassan...            | a 67            | b 19                  | b 42              | 190                       | 166.0         | 76.5             | 56                             | 63                              |
| <i>M. pleiharicus</i> .....     | Barneo, near Sanda<br>Kan.     | a 66            | .....                 | .....             | 190                       | 169.0         | 79.0             | 58                             | 65                              |
| Do.....                         | Borneo, Kinabatangan<br>River. | c 75            | .....                 | .....             | 190                       | 165.0         | 78.5             | 60                             | 69                              |
| <i>M. moschatus</i> .....       | Sumatra, Tarussan<br>Bay.      | a 87            | 24.9                  | 55                | 202                       | 179.5         | 84.0             | (d)                            | (d)                             |
| <i>M. grandicornis</i> .....    | Tenasserim, Tanjong<br>Badak.  | a 96            | 25.4                  | 56                | 202                       | 178.0         | 86.0             | 63                             | 74                              |
| Do.....                         | do.....                        | a 118           | 36.3                  | 80                | 210                       | 184.0         | 97.0             | 58                             | 67                              |

<sup>a</sup> From dried skin.

<sup>b</sup> Uterus contained a nearly mature embryo.

<sup>d</sup> Last molars not through alveoli.

<sup>c</sup> From mounted skin.

#### RUSA BROOKEI (Hose).

Five specimens of a Sambar were obtained by Doctor Abbott on Billiton, which I have referred to this species with some hesitation. A study of the specimens of Malayan *Rusa* in the National Museum shows that the Sambars from Billiton, Borneo, Pagi Island, and Nias Island are distinctly smaller than specimens of *Rusa equina* from the Malay Peninsula. (See table of measurements, page 585.) It is possible that they may represent more than one form. In *Deer of All Lands*, Lydekker calls the peninsular and island forms all *equina*, and on page 153 considers that Hose's *brookei* is identical with the common Bornean Sambar. It would thus appear that the name *brookei* should be



applied to the small form represented by the Bornean animal, and provisionally to the other insular specimens.

No Sambars were obtained on Banka.

*Measurements of specimens of Rusa from Malay Peninsula and Archipelago.*

| Locality.                              | Number. | Age.             | Sex.         | Measurements           |                                |                                            |                                              |                                             |                                                            |
|----------------------------------------|---------|------------------|--------------|------------------------|--------------------------------|--------------------------------------------|----------------------------------------------|---------------------------------------------|------------------------------------------------------------|
|                                        |         |                  |              | Basal length of skull. | Maxillary tooth row (alveoli). | Length of antler along convexity of curve. | Burr to tip of frontal time along convexity. | Circumference of antler above frontal time. | Tip of apical tine to its angle with main trunk of antler. |
| Malay Peninsula: Victoria Island.      | 124004  | Adult.....       | Male .....   | mm.                    | mm.                            | mm.                                        | mm.                                          | mm.                                         | mm.                                                        |
| Malay Peninsula: Tenasserim; Maliwun.  | 124243  | .....do.....     | .....do..... | 350                    | 111                            | 680                                        | 400                                          | 140                                         | 35                                                         |
| Do.....                                | 104091  | Aged adult.....  | .....do..... | 370                    | 105                            | 620                                        | α 135                                        | α 295                                       | 80                                                         |
| Malay Peninsula: Victoria Island.      | 124005  | Adult.....       | .....do..... | 345                    | 112                            | 570                                        | 300                                          | 122                                         | 90                                                         |
| Malay Peninsula: Tenasserim; Maliwun.  | 112172  | Young.....       | .....do..... | 328                    | 109                            | 470                                        | 95                                           | 94                                          | 155                                                        |
| Malay Peninsula: Pahang; Rumpin River. | 115382  | Younger.....     | .....do..... | 290                    | (b)                            | 110                                        | (c)                                          | (c)                                         | (c)                                                        |
| Malay Peninsula: Sungei Balik.         | 111985  | Adult.....       | Female. .... | 350                    | 105                            | .....                                      | .....                                        | .....                                       | .....                                                      |
| Billiton: Buding Kampong               | 124989  | .....do.....     | Male .....   | .....                  | .....                          | 530                                        | 205                                          | 122                                         | 195                                                        |
| Do.....                                | 124990  | .....do.....     | .....do..... | .....                  | .....                          | 460                                        | 195                                          | 100                                         | 90                                                         |
| Do.....                                | 124991  | .....do.....     | .....do..... | .....                  | .....                          | 396                                        | 170                                          | 100                                         | 50                                                         |
| Do.....                                | 124988  | .....do.....     | .....do..... | .....                  | .....                          | 170                                        | (c)                                          | (c)                                         | (c)                                                        |
| Billiton: Buding Bay                   | 124973  | Nearly adult ..  | Female. .... | 300                    | 101                            | .....                                      | .....                                        | .....                                       | .....                                                      |
| Borneo: Kapuas River                   | 142356  | Adult.....       | Male .....   | .....                  | .....                          | 462                                        | 160                                          | 132                                         | 50                                                         |
| Do.....                                | 142357  | Nearly adult ..  | .....do..... | 332                    | 105                            | 325                                        | 136                                          | 84                                          | 33                                                         |
| Pagi Islands: North Pagi.              | 121514  | Aged adult ..... | .....do..... | 315                    | 101                            | 415                                        | 310                                          | 110                                         | 70                                                         |
| Do.....                                | 121887  | Adult.....       | .....do..... | .....                  | .....                          | 415                                        | 305                                          | 100                                         | 65                                                         |
| Do.....                                | 121515  | Nearly adult ..  | .....do..... | 290                    | 98                             | 360                                        | 165                                          | 98                                          | 65                                                         |
| Nias Islands: Siaba Bay.               | 121856  | Adult.....       | .....do..... | .....                  | .....                          | 500                                        | 255                                          | 115                                         | 120                                                        |
| Nias Islands: Telok Dalam              | 141183  | .....do.....     | .....do..... | .....                  | .....                          | 490                                        | 300                                          | 152                                         | 95                                                         |
| Do.....                                | 141182  | .....do.....     | .....do..... | .....                  | .....                          | 480                                        | 310                                          | 115                                         | 60                                                         |
| Do.....                                | 141181  | .....do.....     | .....do..... | .....                  | .....                          | 460                                        | 255                                          | 135                                         | 35                                                         |
| Nias Islands: Lafau                    | 121858  | .....do.....     | .....do..... | .....                  | .....                          | 450                                        | 265                                          | 115                                         | 60                                                         |
| Nias Islands: Siaba Bay.               | 121857  | .....do.....     | .....do..... | .....                  | .....                          | 370                                        | 215                                          | 108                                         | 105                                                        |

<sup>a</sup> These numbers are not interchanged; the antlers are short and very stout and heavy.

<sup>b</sup> Last upper molar not in place.

<sup>c</sup> Spike antler.

**SUS OI Miller.**

Four pigs were secured on the island of Banka, which Mr. Miller has identified as *Sus oi*.<sup>a</sup>

No pigs were taken by Doctor Abbott on the island of Billiton.

**RATUFA POLIA, new species.**

1890. *Sciurus albiceps* JENTINK, Notes Leyden Museum, XII, p. 151, March, 1890.

1905. *Ratufa albiceps* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 237.

*Type*.—Adult female, skin and skull, Cat. No. 125004, U.S.N.M., collected at Bukit Menguru, island of Billiton, between Sumatra and Borneo, August 9, 1904, by Dr. W. L. Abbott. Original number 3551.

<sup>a</sup> For a full consideration of these specimens see Notes on Malayan Pigs, by Gerrit S. Miller, jr., Proc. U. S. Nat. Mus., XXX, pp. 741 and 742, June 13, 1906.

*Diagnostic characters.* Like *Ratufa ephippium* from Borneo, but with a distinctly gray or dirty-white head, sides more grizzled and less reddish.

*Color.*—Type: Upper surface of neck, body, and the sides a grizzle of ochraceous (a little lighter than that of Ridgway) and black, the latter predominating in the median line and forming an ill-defined broad streak on the lower back, the ochraceous predominating about the shoulder and anterior half of the sides, the two colors about equally mixed along the posterior half of the sides. Lower throat, underparts of body, inner side of legs, ochraceous. Nose, cheeks, insides of ears, and extreme upper part of throat dirty white or cream-buff; top of head a grizzle of black and cream-buff; side of neck for about 10 mm. posterior to ear rather light ochraceous, devoid of black grizzling, extending upward to outer surface of ear, where it becomes buffy. Fringe on outer surface of forearm tawny; fore feet dull ochraceous; outside of foreleg similar to sides of body, inner side ochraceous. Hind feet ochraceous; lower leg and thigh a dark or almost tawny ochraceous, the upper and outer surface of the thigh being encroached on by the grizzling of the sides of the body. Upper surface of tail dark brown, something between Ridgway's burnt umber and seal brown, almost black at the extreme tip; underside of tail similar for outer half of hairs, inner half of hairs dull ochraceous, the short appressed hairs clear ochraceous.

*Skull and teeth.*—These closely resemble those of specimens of *Ratufa ephippium* from western Borneo.

*Measurements.*—Type: Head and body, 345 mm.; tail vertebrae, 337; hind foot, 79 (74). Skull of type: Upper length, 64.0; basal length, 53.6; basilar length, 50.2; palatal length, 29.1; condylo-basal length, 57.8; zygomatic breadth, 41.1; interorbital constriction, 27.6; constriction behind postorbital processes, 21.8; diastema, 15.5; maxillary tooth row (alveoli), 13.5; mandible, back of condyle to front of symphysis, 41.2; mandibular tooth row (alveoli), 12.7. For measurements of the series see table, page 589.

*Specimens examined.*—Thirteen; see table, page 589.

*Remarks.*—None of the series examined show any marked deviation in color from the type. The amount of white or gray on the head is subject to some variation, being more extensive on the top of the head in some individuals than in others. In Cat. Nos. 124932 and 124974, U.S.N.M., the tawny-ochraceous of the hind legs is replaced by a sort of dull ochraceous. Only one of the specimens, Cat. No. 125008, U.S.N.M., is in old worn pelage; the black of its upper parts has been bleached to a dull brown, or brownish black. Some of the other specimens have the tails dull brownish black. On holding Cat. No. 124975, U.S.N.M., an immature female, in certain lights there can be made out 13 indistinct rings in the tail caused by narrow

(about 3 mm. wide) terminal and subterminal ferruginous bands on the otherwise black hairs. Some of the other specimens when looked at in certain lights show indistinct annulations on the tail, especially Cat. No. 125008, U.S.N.M., the one in worn pelage, which shows 6 indistinct blackish brown bands on the tail (15–30 mm. wide) alternating with the dull brown of the rest of the tail.

*Ratufa polia* differs from *R. ephippium* in its marked gray head, in which respect it resembles *R. hypoleuca* of Sumatra; but in *hypoleuca* the underparts are white, in marked contrast to the sides, and the head is less white. The affinities of *Ratufa polia* are clearly with the Bornean form.

As Jentink identified the Billiton giant squirrel as *Sciurus albiceps* Desmarest, the following notes made by Mr. Gerrit S. Miller, jr., on the type in the Paris Museum will prove of interest and show that *Ratufa polia* needs no comparison with *R. albiceps*:

*Ratufa albiceps* (Desmarest) type, mounted. Adult female, nursing. On base of stand. "Écureuil à tête blanche de Java, par Leschenault 1808, *S. albiceps* (Desm.) type." The specimen represents a species I have never seen. In general it may be described as a small *bicolor* with normal tail, but *palliata* back so developed that the mantle covers the entire back, sides, and forelegs, allowing the black to appear nowhere except on front feet, a narrow line along posterior edge of front leg and on hind feet, legs, and thighs, the thighs showing some of the characteristic *bicolor* speckling; entire head and distal portion of neck white, a fairly well-defined brownish streak 7 mm. wide extending back from ear to join brown of neck. Underparts and inner surface of legs dirty yellowish. The light tips of the hairs of the tail are dirty white without trace of yellow; but the yellow may easily have been bleached out. They are about the normal extent for *bicolor*. Proximal fifth of tail concolor with hind legs—that is, a mixture of blackish and a dull indefinite brown beneath the surface. Lines of demarcation everywhere well defined except between white of head and colors of back and breast. Ears in bad condition, but apparently whitish inside and brownish outside. Whiskers blackish. Measurements from mounted specimen: Head and body, 350; tail vertebrae, 320; hind foot, 65 (60); outer toe and claw, 21.

#### RATUFA POLIA BANCANA, new subspecies.

*Type*.—Adult male, skin and skull, Cat. No. 124680 U.S.N.M., collected at Tanjong Rengsam, island of Banka, east of Sumatra, May 27, 1904, by Dr. W. L. Abbott. Original number 3277.

*Diagnostic characters*.—Like *Ratufa polia* from Billiton, but forefeet lighter in color, less white on head, and teeth smaller.

*Color*.—Type: Upper surface of neck, body, and the sides a grizzle of ochraceous (a little lighter than that of Ridgway) and brownish or dull black, the latter predominating in the median line, where it forms an ill-defined dark stripe, the two colors equally mixed along the sides. About the shoulder, especially anteriorly and on outer surface of upper arm, the ochraceous is replaced by a dirty white or cream-buff color. Lower throat, underparts of body, inner sides of legs, light ochraceous or almost ochraceous-buff. Nose and cheeks, dirty

white, with dark bases of hairs showing. Top of head, brownish black, rather sparingly sprinkled with dirty white. Inner side of ears and small area in front of ear, cream-buff. Outer side of ear and side of neck for about 10 mm. behind ear ochraceous-buff, devoid of black grizzling. Fringe on outer surface of forearm, light tawny ochraceous; outer side of foreleg a grizzle of dull black and dirty white, dissimilar to sides of body; inner side of foreleg ochraceous-buff, deeper than that of Ridgway; lower foreleg and foot generally buffy. Hind feet, light, ochraceous-buff; inside of hind leg and thigh light ochraceous-buff, the longer hairs bordering the inner side tawny ochraceous. Outer surface of hind leg almost as far as heel similar to sides of body. Upper surface of tail dark brown, something between Ridgway's burnt umber and seal brown; underside of tail, blackish for the outer half or two-thirds of the hairs; inner half of hairs between buff and ochraceous-buff, the short, median appressed hairs ochraceous.

*Skull and teeth.*—In the great majority of cases *Ratufa polia bancana* can be readily separated from *Ratufa polia* by the distinctly shorter length of its tooth row and smaller teeth; but a few of the skulls in the two series can not be so distinguished.

*Measurements.*—Type: Head and body, 345 mm.; tail vertebræ, 425; hind foot, 76 (71). Skull of type: Upper length, 64.5; basal length, 54.0; basilar length, 50.9; condylo-basal length, 58.7; palatal length, 28.7; zygomatic breadth, 39.5; interorbital constriction, 26.8; constriction behind postorbital processes, 21.6; diastema, 15.6; maxillary tooth row (alveoli), 12.1; mandible, back of condyle to front of symphysis, 40.4; mandibular tooth row, 13. For measurements of the series see table, page 589.

*Specimens examined.*—Fourteen; see table, page 589.

*Remarks.*—Most of the specimens of *Ratufa polia bancana* are in old worn and bleached pelage, so that, in comparing the series as a whole with that of *Ratufa polia*, the two look very different. But by comparing individuals in like stages of wear the differences, while apparent and constant, are not so great. In the Banka animal the fore and hind feet are lighter than they are in the Billiton one; the cheeks and sides of the neck are lighter; the forearm and anterior shoulder area are dirty white grizzled with blackish, instead of ochraceous with black grizzling. In the Banka form the heads are less gray than in the typical form, but, as in the Billiton animal, the amount of light coloring is somewhat variable. Some of the specimens show the indistinct rings on the tails, such as are seen in *R. polia*.



*External and cranial measurements of Ratufas from Banka and Billiton.*

| Name.                           | Locality.       | Num-ber. | Sex.     | Head and body. | Tail vertebrae. | Hind foot with claws. | Upper length of skull. | Zygomatic breadth. | Interorbital constriction. | Maxillary tooth row (alveoli). |
|---------------------------------|-----------------|----------|----------|----------------|-----------------|-----------------------|------------------------|--------------------|----------------------------|--------------------------------|
|                                 |                 |          |          | mm.            | mm.             | mm.                   | mm.                    | mm.                | mm.                        | mm.                            |
| <i>Ratufa polia bancana</i> ... | Rengsam Point.  | 124674   | Male.... | 325            | 357             | 77                    | 61.7                   | 38.8               | 25.5                       | 12.0                           |
| Do .....                        | do .....        | 124675   | do ..... | 340            | 390             | 81                    | 65.1                   | 38.4               | 25.3                       | 12.4                           |
| Do .....                        | do .....        | 124676   | do ..... | 340            | 415             | 75                    | 63.5                   | 38.9               | 26.1                       | 12.2                           |
| Do .....                        | do .....        | 124677   | do ..... | 340            | .....           | 79                    | 62.0                   | 38.5               | 24.7                       | 12.5                           |
| Do .....                        | do .....        | 124678   | Female.  | 345            | 370             | 78                    | 64.0                   | 39.4               | 26.2                       | 12.3                           |
| Do .....                        | do .....        | 124679   | do ..... | 335            | 370             | 79                    | 64.1                   | 38.4               | 25.9                       | 12.1                           |
| Do .....                        | do .....        | 124680   | Male.... | 345            | 425             | 76                    | 64.5                   | 39.5               | 26.8                       | 12.1                           |
| Do .....                        | Bedaan Point.   | 124743   | do ..... | 345            | 390             | 77                    | 63.2                   | 39.2               | 25.8                       | 12.8                           |
| Do .....                        | Bukit Parmasan. | 124748   | do ..... | 330            | 340             | 78                    | 61.4                   | 39.5               | 26.5                       | 13.0                           |
| Do .....                        | do .....        | 124749   | do ..... | 340            | 365             | 78                    | .....                  | .....              | 26.4                       | .....                          |
| Do .....                        | Klabat Bay....  | 124868   | Female.  | 345            | 385             | 81                    | 64.5                   | 39.0               | 26.6                       | 12.5                           |
| Do .....                        | do .....        | 124869   | do ..... | 325            | 380             | 79                    | 62.7                   | 39.5               | 26.4                       | 12.0                           |
| Do .....                        | do .....        | 124870   | Male.... | 335            | 400             | 79                    | 62.8                   | 39.9               | 26.0                       | 12.0                           |
| Do .....                        | do .....        | 124871   | do ..... | 340            | 400             | 77                    | 62.8                   | 38.9               | 26.5                       | 13.0                           |
| <i>Ratufa polia</i> .....       | Batu Point .    | 124932   | Female.  | 320            | 370             | 74                    | 62.8                   | 38.1               | 26.0                       | 13.4                           |
| Do .....                        | Buding Bay .    | 124974   | do ..... | 340            | 390             | 77                    | 63.3                   | 40.5               | 27.1                       | 12.7                           |
| Do .....                        | do .....        | 124975   | do ..... | 295            | 370             | 76                    | 59.4                   | 35.7               | 23.0                       | 12.4                           |
| Do .....                        | Poetak Point... | 124993   | do ..... | 348            | 385             | 78                    | 64.5                   | 40.7               | 28.4                       | 13.2                           |
| Do .....                        | Bukit Menguru.  | 125004   | do ..... | 345            | 377             | 79                    | 64.0                   | 41.1               | 27.6                       | 13.5                           |
| Do .....                        | do .....        | 125005   | Male.... | 337            | 352             | 77                    | 61.8                   | 38.4               | 25.7                       | 13.0                           |
| Do .....                        | do .....        | 125006   | do ..... | 345            | 390             | 77                    | 63.2                   | 39.1               | 25.8                       | 12.9                           |
| Do .....                        | do .....        | 125007   | Female.  | 335            | 380             | 78                    | 65.0                   | 40.2               | 26.7                       | 13.4                           |
| Do .....                        | do .....        | 125008   | Male.... | 360            | 367             | 81                    | 63.5                   | 40.5               | 26.7                       | 13.1                           |
| Do .....                        | do .....        | 125009   | do ..... | 340            | 380             | 78                    | 63.9                   | 40.1               | 26.5                       | 13.3                           |
| Do .....                        | do .....        | 125010   | Female.  | 330            | 375             | 75                    | 62.8                   | 39.5               | 26.6                       | 12.8                           |
| Do .....                        | do .....        | 125011   | do ..... | 340            | 365             | 71                    | 64.7                   | 40.7               | 28.2                       | 12.7                           |
| Do .....                        | do .....        | 125012   | Male.... | 340            | 375             | 76                    | 61.8                   | 40.9               | 27.2                       | 12.8                           |

♂ Type.

♂ Immature.

**SCIURUS BANGKANUS** Schlegel.

1863. *Sciurus prevostii bangkanus* SCHLEGEL, Nederlandsch Tijdsch. Dierkunde, I, p. 26, pl. I, fig. 2.

1888. *Sciurus prevostii* JENTINK, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, p. 26.

1905. *Sciurus prevostii* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 240.

For list of specimens and measurements see table, page 591. This series of topotypes differs in color from Schlegel's very good figure as follows: Tawny of the underparts deeper and darker, nearly like Ridgway's tawny; no pronounced black stripe bordering the tawny, the tawny merely much darker with the basal half of the hairs blackish; shoulder slightly more yellowish than in the figure.

**SCIURUS MENDANAUS**, new species.

1890. *Sciurus prevostii* JENTINK, Notes Leyden Museum, XII, p. 149, March 10, 1890.

1905. *Sciurus prevostii* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 240.

*Type*.—Adult male, skin and skull, Cat. No. 124916, U.S.N.M., collected on Pulo Mendanau, west of Billiton Island, Malay Archipelago, July 14, 1904, by Dr. W. L. Abbott. Original number 3475.

*Diagnostic characters*.—Similar to *Sciurus carimatae* Miller; but underparts and shoulder darker. Differs from *Sciurus rafflesi* in its much lighter shoulder.

*Color*.—Type: Upper parts of head, neck, and body and a narrow stripe on outer surface of hind leg black. Underparts, fore legs, and feet, and inner surface of hind legs and feet, deep, rich ferruginous, brightest on the throat, darkest on the forearm and on the feet, where the color approaches hazel. The white stripe extends from behind the shoulder to the heel. In the region of the hips it is widest and encroached on by the black, which makes a slight grizzle. Area at base of whiskers and chin, white slightly grizzled with black. Sides of head and neck a fine grizzle of black and white, the former in excess. White spot on cheek indistinct. Shoulder orange-ochraceous, grizzled with black, due to bases of hairs showing, blending in with the deep rich ferruginous of the arm, and with the white of the side stripe. Tail uniformly black, but not so deep and clear as on the back.

*Skull*.—Not distinguishable with certainty from that of *Sciurus carimatae*; maxillary tooth row a little longer.

*Measurements*.—External measurements of the type: Figures in parentheses are measurements of a cotype of *Sciurus rafflesi* (No. 84.6, 3.8, Sumatra Raffles—British Museum) and the type of *S. carimatae*. Total length, 448 mm. (—, 428); head and body, 238 (—, 243); tail vertebræ, 210 (—, 185); hind foot with claws, 55 (56, 52); hind foot without claws, 51 (51, 47).

Cranial measurements of the type, of a cotype of *S. rafflesi* and the type of *S. carimatae*: Greatest length, 54 mm. (55, 53.5); basal length, 46.5 (48.6, 46.5); basilar length, 43.5 (45.6, 43.5); palatilar length, 23.5 (24.8, 23); diastema, 13.5 (13.6, 13); zygomatic breadth, 33 (31, 32.5); interorbital constriction, 22 (23, 21); least depth of ramus of mandible in front of tooth row, 5 (5, 5); maxillary tooth row (alveoli), 11.25 (11.4, 10); mandibular tooth row, 11 (11.4, 10).

*Specimens examined*.—See table, page 591.

*Remarks*.—The series of specimens is very uniform in color and pattern, and none show any deviation from the type. *Sciurus mendanauus* is easily distinguishable from *S. carimatae* by its darker shoulder and underparts and by the greater length of the tooth rows of the skulls. From *S. rafflesi* of Sumatra it differs in its slightly smaller size and much lighter shoulder. Mr. Miller, in comparing specimens of *S. melanops* with cotype No. 84.6, 3.8 of *S. rafflesi* from Sumatra, in the British Museum, noted that the shoulder in the latter has the palest red, about the same in color as the darkest at the side of the wrist of a specimen of *S. melanops* (Cat. No. 113153, U.S.N.M.)—that is, a deep rich ferruginous of Ridgway. His notes do not show whether or not the shoulder of *S. rafflesi* is grizzled as it is in *S. mendanauus*, but if it is he would hardly have failed to remark on

it in comparing it with *S. melanops*, in which the shoulder is not grizzled. In pattern and color *S. mendanawus* is nearly identical with *S. bangkanus*; the shoulder in the latter is lighter and in some specimens inclining to grayish, but the Banka squirrel is much larger. See table, page 591.

*External and cranial measurements of Sciurus bangkanus and of Sciurus mendanawus.*

| Name.                         | Locality.           | Number.             | Sex.       | Head and body. | Tail vertebre. | Hind foot with claws. | Upper length of skull. | Zygomatic breadth. | Least orbital width. |
|-------------------------------|---------------------|---------------------|------------|----------------|----------------|-----------------------|------------------------|--------------------|----------------------|
| <i>Sciurus bangkanus</i> ...  | Banka, Rengsam ...  | 124681              | Female...  | 269            | 245            | 60                    | 57.0                   | 35.5               | 24.5                 |
| Do.....                       | do .....            | 124682              | Male ..... | 268            | 265            | 61                    | 58.0                   | 37.0               | 24.5                 |
| Do.....                       | Banka, Pamuja ..... | 124762              | do .....   | 264            | 268            | 62                    | 58.0                   | 36.0               | 24.5                 |
| Do.....                       | Banka, Klabat Bay.  | 124872              | Female...  | 270            | 270            | 60                    | 59.0                   | 35.0               | 24.0                 |
| Do.....                       | do .....            | 124873              | do .....   | 272            | 280            | 62                    | 60.0                   | 37.0               | 24.0                 |
| <i>Sciurus mendanawus</i> ... | Mendanau...         | 124911              | Male ..... | 235            | 212            | 57                    | 54.0                   | 32.0               | 22.0                 |
| Do.....                       | do .....            | 124912              | do .....   | 235            | 215            | 58                    | 52.0                   | 33.0               | 22.0                 |
| Do.....                       | do .....            | 124913              | Female...  | 230            | 220            | 56                    | 54.0                   | 34.0               | 22.5                 |
| Do.....                       | do .....            | 124914              | do .....   | 245            | 210            | 57                    | 55.0                   | 34.0               | 23.0                 |
| Do.....                       | do .....            | 124915              | Male ..... | 230            | 218            | 55                    | 54.0                   | 34.0               | 23.0                 |
| Do.....                       | do .....            | <sup>a</sup> 124916 | do .....   | 238            | 210            | 55                    | 53.5                   | 33.0               | 22.0                 |
| Do.....                       | do .....            | 124917              | Female...  | 238            | 205            | 53                    | 53.0                   | 32.5               | 22.0                 |
| Do.....                       | do .....            | <sup>b</sup> 124918 | Male ..... | 270            | 210            | 54                    | .....                  | .....              | .....                |
| Do.....                       | do .....            | <sup>b</sup> 124919 | do .....   | 260            | 205            | 56                    | .....                  | .....              | .....                |
| Do.....                       | do .....            | 124920              | do .....   | 230            | 204            | 55                    | 52.0                   | 33.0               | 22.0                 |
| Do.....                       | do .....            | 124921              | Female...  | 237            | .....          | 55                    | 53.0                   | 33.0               | 22.0                 |

<sup>a</sup> Type.

<sup>b</sup> Alcoholic.

**SCIURUS TEDONGUS, new species.**

1888. *Sciurus badjing* JENTINK, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères.

1905. *Sciurus nobilis* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 240.

*Type*.—Adult male, skin and skull, Cat. No. 124717, U.S.N.M., collected at Tanjong Tedong, island of Banka, east of Sumatra, June 1, 1904, by Dr. W. L. Abbott. Original number 3285.

*Diagnostic characters*.—Similar to *Sciurus peninsularis* Miller, from the Malay Peninsula and eastern Sumatra, but white and black stripes along side not so broad and clear. Outer surface of legs and upper surface of feet with a slight suffusion of the orange-rufous of the underparts, found to a slight extent only in *S. peninsularis*, and to the same extent in *S. billitonis*. Differs from *S. billitonis* only in shorter length of maxillary tooth row and tendency for tip of tail to be redder.

*Color*.—Type: Upper parts and tail a fine grizzle of black and ochraceous-buff, inclining toward olive-buff on the tail, the two colors in about equal proportions. Underparts and inner surface of legs ochraceous rufous. A slight wash of this color extends on the outer surface of the legs, becoming marked on the upper surface of the feet. Lateral stripes as in *Sciurus citatus* (comparison with specimens from

Tapanuli Bay, western Sumatra), the outer about 3 mm. wide at the middle, dirty buff in color; the inner about 5 mm. wide, black, with a slight grizzling of the ochraceous rufous of the underparts. Sides of head and under surface of tail similar in color to outer surfaces of legs.

*Measurements.*—See table, page 592.

*Specimens examined.*—Eleven; see table, page 592.

*Remarks.*—This squirrel is distinguishable in color from *Sciurus vittatus* (specimens from Tapanuli Bay, western Sumatra) by its less yellow cheeks and distinctly rufous feet. From *S. peninsularis* it is distinguished by the narrow dirty buff instead of whitish cream-buff side stripe and by the narrower less clear black side stripe and the greater suffusion of the ochraceous rufous of the underparts on the feet. Skins of *S. tedongus* are practically indistinguishable from those of *S. billitonus*, though the hind foot averages a little smaller (see table p. 592) and the tips of the tails are inclined to tawny.

The skulls of *Sciurus tedongus* differ from those of *S. billitonus* in the shorter length of the maxillary tooth row (9 mm. as against 10 mm.), but are indistinguishable from skulls of *S. peninsularis* in this respect.

*External and cranial measurements of plantain squirrels from Banka and Billiton.*

| Name.                        | Locality.               | Number.             | Sex.    | Head and body.<br>mm. | Tail vertebrae.<br>mm. | Hind foot.<br>mm. | Upper length of<br>skull.<br>mm. | Zygomatic<br>breadth.<br>mm. | Interorbital<br>constriction.<br>mm. | Upper tooth row<br>(alveoli).<br>mm. |
|------------------------------|-------------------------|---------------------|---------|-----------------------|------------------------|-------------------|----------------------------------|------------------------------|--------------------------------------|--------------------------------------|
| <i>Sciurus tedongus</i> ..   | Banka, Rengsam Point    | 124683              | Female. | 210                   | 175                    | 44                | 47.5                             | 28.0                         | 16.0                                 | 9.0                                  |
| Do. ....                     | do. ....                | 124684              | Male    | 220                   | 190                    | 47                | 49.5                             | 28.5                         | 16.5                                 | 9.0                                  |
| Do. ....                     | do. ....                | 124685              | do.     | 205                   | 180                    | 49                | 49.0                             | 29.0                         | 17.0                                 | 9.0                                  |
| Do. ....                     | do. ....                | 124686              | do.     | 210                   | 180                    | 48                | 49.0                             | 28.5                         | 16.0                                 | 9.0                                  |
| Do. ....                     | do. ....                | 124687              | do.     | 215                   | 175                    | 48                | 47.0                             | 29.0                         | 17.0                                 | 8.7                                  |
| Do. ....                     | do. ....                | 124688              | do.     | 200                   | 181                    | 46                | 48.0                             | 28.0                         | 16.0                                 | 9.0                                  |
| Do. ....                     | do. ....                | 124689.             | Female. | 205                   | 175                    | 47                | 48.0                             | 28.0                         | 16.5                                 | 9.0                                  |
| Do. ....                     | Banka, Tedong Point.    | <sup>a</sup> 124717 | Male    | 207                   | 167                    | 48                | 48.0                             | 29.0                         | 17.5                                 | 9.0                                  |
| Do. ....                     | Banka, Bedaan Point.    | 124744              | do.     | 210                   | 165                    | 45                | 47.0                             | 28.0                         | 17.0                                 | 9.0                                  |
| Do. ....                     | Banka, Klabat Bay ..    | <sup>b</sup> 124874 | Female. | 225                   | 175                    | 48                | (b)                              |                              |                                      |                                      |
| Do. ....                     | do. ....                | 124745              | Male    | (c)                   |                        |                   | 47.0                             | 28.5                         | 17.0                                 | 9.0                                  |
| <i>Sciurus billitonus</i> .. | Billiton, Batu Point .. | 124933              | do.     | 220                   | 175                    | 50                |                                  | 29.0                         | 17.0                                 | 10.0                                 |
| Do. ....                     | do. ....                | 124934              | do.     | 210                   | 185                    | 50                | 50.0                             | 31.0                         | 18.0                                 | 10.5                                 |
| Do. ....                     | do. ....                | 124935              | do.     | 215                   | 175                    | 52                | 48.0                             | 28.5                         | 17.0                                 | 9.5                                  |
| Do. ....                     | do. ....                | 124936              | Female. | 210                   | 170                    | 49                | 48.5                             | 28.5                         | 17.0                                 | 9.5                                  |
| Do. ....                     | do. ....                | 124937              | do.     | 217                   | 130                    | 51                | 50.0                             | 29.5                         | 17.5                                 | 9.7                                  |
| Do. ....                     | do. ....                | 124938              | do.     | 213                   | 172                    | 49                | 49.5                             | 29.5                         | 17.0                                 | 10.0                                 |
| Do. ....                     | do. ....                | 124939              | Male    | 216                   | 175                    | 50                |                                  | 30.0                         | 18.0                                 | 9.5                                  |
| Do. ....                     | do. ....                | <sup>a</sup> 124940 | do.     | 185                   | 175                    | 48                | (b)                              | 26.5                         | 15.0                                 | 9.5                                  |
| Do. ....                     | do. ....                | 124941              | do.     | 213                   | 177                    | 50                | 46.0                             |                              |                                      |                                      |
| Do. ....                     | Billiton, Pinggi Point. | 124972              | do.     | 215                   | 180                    | 50                | 48.0                             | 29.0                         | 17.0                                 | 10.0                                 |
| Do. ....                     | Billiton, Buding Bay .. | 124976              | Female. | 227                   | 150                    | 48                | 50.0                             | 31.0                         | 17.5                                 | 9.7                                  |
| Do. ....                     | do. ....                | <sup>a</sup> 124977 | do.     | 225                   | 170                    | 50                | 50.0                             | 30.0                         | 16.5                                 | 10.0                                 |
| Do. ....                     | Billiton, Batu Point .. | <sup>b</sup> 124942 | do.     | 225                   | 160                    | 47                | (b)                              |                              |                                      |                                      |

<sup>a</sup> Type.

<sup>b</sup> Alcoholic.

<sup>c</sup> No skin.

<sup>d</sup> Not fully adult.

### SCIURUS BILLITONUS, new species.

1890. *Sciurus notatus* JENTINK, Notes Leyden Museum, XII, March 12, 1890, p. 152.

1905. *Sciurus notatus* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 240.



*Type*.—Adult female, skin and skull, Cat. No. 124977, U.S.N.M., collected at Buding Bay, island of Billiton, between Sumatra and Borneo, August 5, 1904, by Dr. W. L. Abbott. Original number 3539.

*Diagnostic characters*.—Similar to *Sciurus peninsularis* and to *S. tedongus*. Black and white stripes on sides not so wide and clear as in *S. peninsularis*. Tip of tail not so much inclined to reddish as in either. Outer surface of legs and upper surface of feet suffused with orange-rufous of underparts as in *S. tedongus*, much more than in *S. peninsularis*. Maxillary tooth row averaging about 1 mm. longer than in *S. peninsularis*, *vittatus* or *tedongus*.

*Color*.—Type: Upper parts and tail a fine grizzle of black and a color lying between ochraceous-buff and a pale tawny olive; the black rather in excess on the body, and the two about equally mixed in the tail. Underparts and inner surface of legs ochraceous rufous. A slight wash of this color extends on the outer surfaces of the legs, becoming marked on the upper surface of the feet. Lateral stripes as in *Sciurus vittatus* from Tapanuli Bay, Sumatra, the outer about 3 mm. wide at the middle, dirty buff, the inner about 7 mm. wide, black with a very slight grizzling of the ochraceous rufous of the underparts. Sides of head and under surface of tail similar to outer surface of legs.

*Measurements*.—See table, page 592.

*Specimens examined*.—Thirteen; see table, page 592.

*Remarks*.—This squirrel is distinguishable in color from *Sciurus vittatus* (Tapanuli Bay, Sumatra) by its less yellow cheeks and distinctly rufous feet. From *S. peninsularis* it is distinguished by the narrow dirty buff instead of whitish cream-buff side stripe and by the narrower, less clear, black stripe and the greater suffusion of the ochraceous rufous of the underparts on the feet and by the greater length of the maxillary tooth row. Skins of *S. billitonus* are almost indistinguishable from skins of *S. tedongus*, but the hind foot averages a little longer (see table, page 592), and the tips of the tails are not so much inclined to reddish. The skulls of the Banka and Billiton squirrels are easily separable by the greater length of the maxillary tooth row of the latter. (See table, page 592.)

#### SCIUROPTERUS VORDERMANNI Jentink.

1890. *Sciuropterus vordermanni* JENTINK, Notes Leyden Museum, XII, p. 150, pl. vii, figs. 13 and 14, March, 1890.

1905. *Sciuropterus vordermanni* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 233.

Doctor Abbott secured one specimen, an adult female, at Buding Bay, Billiton. Its colors differ in no essential respects from those given in the original description. The skull is exactly like the figures of the type. Measurements: Cat. No. 124986, U.S.N.M. Head and body, 103 mm.; tail vertebrae, 100; tail to end of hairs, 113; hind foot with

claws, 22; ear from meatus, 12; greatest length of skull, 29; nasals, median line, 8; greatest breadth of skull, 17.3; diastema, 5.6; length of upper molar series, 5.5.

### NANNOSCIURUS BANCANUS Lyon.

1888. *Sciurus soricinus* JENTINK, Mus. d'Hist. Nat., XII, Cat. Syst. Mammifères, p. 25.

1905. *Nannosciurus melanotis* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 249.

1906. *Nannosciurus bancanus* LYON, Proc. Biol. Soc., Washington, XIX, p. 55, May 1, 1906.

Represented by 12 specimens, all from the island of Banka. None were secured on Billiton. For table of measurements of this and related species, see page 594.

*External and cranial measurements of pigmy squirrels from Sumatra, Borneo, Java, Sinkap, and Banka.*

| Name.                             | Locality.              | Number. | Sex.    | Head and body. | Tail vertebrae. | Hind foot with claws. | Skull, gnathion to occipito-sphenoid suture. | Greatest breadth. | Interorbital constriction. |
|-----------------------------------|------------------------|---------|---------|----------------|-----------------|-----------------------|----------------------------------------------|-------------------|----------------------------|
|                                   |                        |         |         | mm.            | mm.             | mm.                   | mm.                                          | mm.               | mm.                        |
| <i>Nannosciurus bancanus</i> ...  | Point Tedong ....      | 124718  | Male    | 83             | 65              | 23.0                  | 15.4                                         | 15.7              | 10.0                       |
| Do.....                           | Klabat Bay .....       | 124875  | do      | 85             | 70              | 22.5                  | 15.7                                         | 15.7              | 10.0                       |
| Do.....                           | do.....                | 124876  | do      | 80             | 70              | 22.5                  | 14.9                                         | 16.0              | 10.2                       |
| Do.....                           | do.....                | 124877  | do      | 78             | 65              | 23.6                  | 14.8                                         | 16.4              | 10.3                       |
| Do.....                           | do.....                | 124878  | do      | 90             | 60              | 22.3                  | 15.0                                         | 16.0              | 9.7                        |
| Do.....                           | do.....                | 124879  | do      | 85             | 70              | 23.9                  | 14.9                                         | 16.2              | 10.0                       |
| Do.....                           | do.....                | 124880  | Female. | 82             | 63              | 22.0                  | 14.9                                         | 15.8              | 10.1                       |
| Do.....                           | do.....                | 124881  | do      | 80             | 67              | 22.5                  | 15.5                                         | 16.0              | 10.0                       |
| Do.....                           | do.....                | 124882  | Male    | 85             | 65              | 22.9                  | 15.5                                         | 16.1              | 10.0                       |
| Do.....                           | do.....                | 124883  | do      | 80             | 65              | 23.5                  | .....                                        | .....             | .....                      |
| Do.....                           | do.....                | 124884  | do      | 82             | 70              | 22.4                  | 15.0                                         | 16.2              | 10.2                       |
| Do.....                           | do.....                | 142258  | do      | .....          | .....           | .....                 | 15.6                                         | 14.9              | 10.0                       |
| <i>Nannosciurus borneanus</i> .   | Western Borneo ..      | 142259  | do      | 75             | 65              | 22.5                  | 14.7                                         | .....             | .....                      |
| Do.....                           | do.....                | 142260  | do      | 85             | 68              | 23.0                  | 15.4                                         | 16.2              | 10.0                       |
| Do.....                           | do.....                | 142261  | do      | 80             | 65              | 23.3                  | 15.5                                         | 16.1              | 10.5                       |
| Do.....                           | do.....                | 142262  | do      | 82             | 64              | 23.5                  | 14.8                                         | 15.0              | 10.0                       |
| Do.....                           | do.....                | 142263  | do      | 77             | 65              | 23.7                  | 15.0                                         | 15.8              | 10.2                       |
| Do.....                           | do.....                | 142265  | do      | 85             | 70              | 23.9                  | .....                                        | .....             | .....                      |
| Do.....                           | do.....                | 142266  | do      | 80             | 64              | 22.0                  | .....                                        | .....             | .....                      |
| Do.....                           | do.....                | 142267  | do      | 83             | 45              | 23.0                  | .....                                        | .....             | .....                      |
| Do.....                           | do.....                | 142268  | do      | 78             | 65              | 22.0                  | 15.6                                         | 16.0              | 10.5                       |
| Do.....                           | do.....                | 142269  | do      | 90             | 57              | 23.9                  | 14.7                                         | 15.9              | 10.5                       |
| Do.....                           | do.....                | 142271  | Female. | 86             | 65              | 22.6                  | 15.6                                         | 16.8              | 10.6                       |
| <i>Nannosciurus pulcher</i> ..... | Sinkap Island ....     | 113131  | do      | 88             | 77              | 23.3                  | 16.4                                         | .....             | 11.5                       |
| Do.....                           | do.....                | 123098  | Male    | 85             | 75              | 23.7                  | 16.4                                         | 16.7              | 10.0                       |
| Do.....                           | do.....                | 123099  | Female. | 95             | 70              | 23.3                  | 16.7                                         | 17.2              | 10.3                       |
| <i>Nannosciurus sumatranus</i> .  | Tarussan Bay, Sumatra. | 141058  | Male    | 83             | 72              | 23.8                  | 15.0                                         | 15.8              | 9.6                        |
| <i>Nannosciurus melanotis</i> ... | Batavia .....          | 121494  | Female. | .....          | .....           | 22.5                  | 16.0                                         | 16.5              | 10.0                       |
| Do.....                           | do.....                | 121495  | Male    | .....          | .....           | 22.7                  | 15.5                                         | 16.5              | 9.5                        |
| Do.....                           | do.....                | 121496  | .....   | .....          | .....           | 22.2                  | 15.5                                         | 15.9              | 10.0                       |

<sup>a</sup> Type.

### MUS FIRMUS Miller.

Five large gray rats, secured on Banka, show no appreciable differences from *Mus firmus* Miller, from Linga. No rats of this group were obtained on Billiton. For table of measurements, see page 595.

## MUS CREMORIVENTER Miller.

Three rats of this group were collected on Banka and one on Billiton. They are not appreciably different from *Mus cremoricenter* Miller, of the Malay Peninsula. The Banka specimens are not fully adult; the scales on the tails are a little smaller and the teeth a little larger than they are in the Billiton specimen. The material is too limited for arriving at any positive conclusions. For measurements, see table page 595.

*External and cranial measurements of Mus firmus and Mus cremoriventer.*

| Name.                      | Locality.               | Number. | Sex and age.        | Head and body. | Tail vertebrae. | Hind foot with claws. | Greatest length of skull. | Greatest width of skull. | Maxillary tooth row (alveoli). |
|----------------------------|-------------------------|---------|---------------------|----------------|-----------------|-----------------------|---------------------------|--------------------------|--------------------------------|
| <i>Mus firmus</i> ....     | Banka; Tanjong Rengsam. | 124690  | Female, adult....   | mm.            | mm.             | mm.                   | mm.                       | mm.                      | mm.                            |
| Do.....                    | do.....                 | 124691  | Male, adult.....    | 247            | 307             | 50                    | 54.3                      | 26.1                     | 9.4                            |
| Do.....                    | do.....                 | 124692  | Female, adult.....  | 243            | 273             | 49                    | 52.6                      | 26.3                     | 9.3                            |
| Do.....                    | Banka; Klabat Bay       | 124885  | Male, young.....    | 190            | 209             | 45                    | 45.7                      | 21.6                     | 9.4                            |
| Do.....                    | do.....                 | 124886  | Female, young.....  | 195            | 218             | 46                    | .....                     | .....                    | .....                          |
| <i>Mus cremoriventer</i> . | Banka; Tanjong Rengsam. | 124695  | Female, immature.   | 113            | 153             | 25                    | 30.3                      | 14.6                     | 5.9                            |
| Do.....                    | Banka; Klabat Bay       | 124887  | do.....             | .....          | .....           | .....                 | 30.0                      | 14.0                     | 5.7                            |
| Do.....                    | do.....                 | 124889  | Male, immature..... | 105            | 136             | 26                    | .....                     | 13.8                     | 5.9                            |
| Do.....                    | Billiton; Bukit Menguru | 125021  | Male, adult.....    | 134            | 182             | 26                    | 33.5                      | 15.2                     | 5.7                            |

## MUS NEGLECTUS Jentink.

Doctor Abbott secured the young of a medium-sized rat at Tanjong Poetak, Billiton, which may be referred to this species provisionally. It is so young that the second molars are scarcely up. No rat of this group was taken on Banka.

## MUS ASPER Miller.

Good series of this species were obtained on both Banka and Billiton. Considerable individual variation is seen in the color of the underparts. In some specimens it is almost entirely white or whitish gray, while in others it is very completely washed over with ochraceous buff. The series from the two islands differ in no way from each other nor from specimens from the Malay Peninsula. See table of measurements, page 596.

Measurements of *Mus asper*.

| Locality.                     | Num-ber. | Sex.               | Head and body.<br>mm. | Tail vertebrae.<br>mm. | Hind foot with<br>claws.<br>mm. | Greatest length<br>of skull.<br>mm. | Greatest width<br>of skull.<br>mm. | Maxillary tooth<br>row, (alveoli).<br>mm. |
|-------------------------------|----------|--------------------|-----------------------|------------------------|---------------------------------|-------------------------------------|------------------------------------|-------------------------------------------|
| Banka; Bukit Parmissan .....  | 124750   | Male adult .....   |                       |                        |                                 | 30.0                                |                                    | 5.5                                       |
| Banka; Tanjong Pamuja .....   | 124763   | do .....           | 129                   | 116                    | 31.0                            | 31.7                                | 14.9                               | 5.4                                       |
| Do .....                      | 124764   | do .....           | 147                   | 116                    | 29.5                            |                                     |                                    | 5.2                                       |
| Do .....                      | 124765   | do .....           |                       |                        |                                 | 33.0                                | 15.0                               | 5.5                                       |
| Banka; Klabat Bay .....       | 124896   | do .....           | 130                   | 109                    | 29.5                            |                                     | 15.0                               | 5.4                                       |
| Do .....                      | 124897   | do .....           | 140                   | 115                    | 26.5                            | 32.7                                |                                    | 5.6                                       |
| Banka; Tanjong Rengsam .....  | 124693   | Female adult ..... | 137                   | 120                    | 28.0                            | 33.6                                | 14.8                               | 5.5                                       |
| Banka; Bukit Parmissan .....  | 124751   | do .....           |                       |                        |                                 | 29.8                                | 14.0                               | 5.1                                       |
| Banka; Klabat Bay .....       | 124894   | do .....           |                       |                        |                                 | 30.5                                | 14.6                               | 5.0                                       |
| Do .....                      | 124895   | do .....           | 120                   | 95                     | 28.0                            | 30.5                                | 14.6                               | 5.4                                       |
| Do .....                      | 124898   | do .....           | 139                   | 113                    | 28.0                            | 34.5                                | 15.3                               | 5.6                                       |
| Do .....                      | 124899   | do .....           | 130                   | 118                    | 28.0                            | 33.7                                | 14.9                               | 5.5                                       |
| Do .....                      | 124900   | do .....           | 141                   | 119                    | 27.5                            | 32.4                                | 14.7                               | 5.1                                       |
| Do .....                      | 124901   | do .....           | 141                   | 121                    | 28.0                            | 33.7                                | 14.9                               | 5.0                                       |
| Billiton; Buding Bay .....    | 124978   | Male adult .....   | 117                   | 109                    | 28.5                            | 31.9                                | 14.5                               | 5.4                                       |
| Do .....                      | 124979   | do .....           |                       |                        |                                 | 32.8                                |                                    | 5.0                                       |
| Do .....                      | 124981   | do .....           | 121                   |                        | 27.0                            | 31.4                                | 14.0                               | 5.0                                       |
| Billiton; Bukit Menguru ..... | 125015   | do .....           | 124                   | 102                    | 27.0                            | 29.8                                | 13.5                               | 5.0                                       |
| Do .....                      | 125016   | do .....           | 135                   | 119                    | 29.0                            | 32.8                                | 14.6                               | 5.5                                       |
| Do .....                      | 125017   | do .....           | 134                   | 112                    | 29.0                            | 33.0                                | 15.0                               | 5.0                                       |
| Do .....                      | 125018   | do .....           |                       |                        |                                 | 31.0                                | 14.2                               | 5.0                                       |
| Billiton; Buding Bay .....    | 124982   | Female adult ..... |                       |                        |                                 | 32.1                                | 14.8                               | 5.2                                       |
| Billiton; Bukit Menguru ..... | 125013   | do .....           | 135                   | 123                    | 29.0                            | 32.2                                | 14.4                               | 5.2                                       |
| Do .....                      | 125014   | do .....           | 130                   | 115                    | 27.0                            | 33.7                                | 15.2                               | 5.3                                       |

## MUS CLABATUS, new species,

*Type*.—Old adult female, skin and skull, Cat. No. 124888, U.S.N.M., collected at Klabat Bay, island of Banka, east of Sumatra, June 25, 1904, by Dr. W. L. Abbott. Original number 3439.

*Diagnostic characters*.—A member of the *Mus concolor* group, most like *Mus surdus* Miller from Simalur Island, from which it is indistinguishable externally, but differing from it and the other members of the group in the shape of the external plate of the infraorbital foramen. This plate in *Mus clabatus* is narrow antero-posteriorly and its anterior edge is inclined backward instead of ascending vertically.

*Color*.—Type: Entire upper parts and sides, a coarse ill-defined grizzle of dull ochraceous buff and blackish brown, the former more conspicuous along the sides. Underparts and inner surface of limbs a dirty grayish white. A fairly well-defined line of demarcation between the color of the sides and the belly. Ears, brownish, darker externally, lightly sprinkled with fine brownish hairs inside and out. Feet dirty white. Tail dark uniformly brownish, twelve scales to the centimeter along the middle. Three brownish hairs subtend each scale and about middle of tail equal in length  $1\frac{1}{4}$  scales; at tip of tail they equal about 2 scales in length.

*Mammæ*.—Inguinal 2-2; pectoral 2-2=8.

*Skull and teeth*.—The skull differs from that of all the members of the *Mus concolor* group that I have examined in the narrow external plate of the infraorbital foramen. The anterior edge of this plate



slopes backward and does not project antero-superiorly in a well-marked rounded angle. The audital bulla in *Mus clabatus* is more compressed laterally and deeper dorso-ventrally than it is in the other members of the *concolor* group. The teeth are much worn in the single specimen. Compared with the type of *M. surdus* the last upper molar is reduced in size.

*Measurements.*—Type: Total length, 281 mm.; head and body, 143; tail vertebrae, 138; hind foot, 25; greatest length of skull, 31; palatal length, 17.1; palatilar length, 15.3; zygomatic breadth, 14.9; interorbital constriction, 5.0; nasals, 10.9; diastema, 9.9; width of external plate of infraorbital foramen at middle, 3.7 (in *M. surdus*, type, 4.2); maxillary tooth row (alveoli), 5.6; mandible, condyle to front of symphysis, 18.2; mandibular tooth row (alveoli), 5.2.

*Specimens examined.*—One, the type.

*Remarks.*—*Mus clabatus*, while indistinguishable externally from *M. surdus*, is easily separable by the shape of the external plate of the infraorbital foramen, not only from it, but also from *Mus concolor* of the Malay Peninsula, from Sumatran and Bornean forms of *concolor* and from *Mus pullus* from Tioman Island.

#### VIVERRA TANGALUNGA Gray.

1905. *Viverra tangelunga* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 210.

Two individuals were collected by Doctor Abbott on the island of Billiton. None were taken on Banka. For table of measurements, see page 600.

#### PARADOXURUS HERMAPHRODITUS (Pallas, in Schreber).

Two Paradoxures were secured in the island of Banka. They show no appreciable differences in respect to color and to shape and size of skull and teeth from specimens of *Paradoxurus hermaphroditus* from the Malay Peninsula. For table of measurements, see page 600.

#### PARADOXURUS CANESCENS, new species.

*Type.*—Skin and skull of adult male, Cat. No. 124943 U.S.N.M., collected at Tanjong Batu, island of Billiton, between Sumatra and Borneo, July 19, 1904, by Dr. W. L. Abbott. Original number 3520.

*Diagnostic characters.*—Similar to *Paradoxurus philippinensis*, of the Philippine Islands and Borneo, but with a decided gray color about the head and the anterior third of the body.

*Color.*—Type: Sides of nose and region of base of whiskers, whitish cream buff; nose and top of nose back as far as line connecting inner canthus of eyes, brownish black, which color extends as a ring about 5 mm. wide around the eye and downward to the lips for a width of 10–12 mm. behind base of whiskers. Ill-defined spot under eye dirty

white, blending into the color of the cheeks which are a grizzle of dirty white and dull black. A small ill-defined blackish spot is found 15–20 mm. posterior to outer canthus of eye. Area between eyes and line connecting anterior edges of ears an indefinite dirty white with a slight amount of the blackish of the bases and the tips of the hairs showing. This dirty white color with almost no blackish showing extends backward along the side of the head, under the ear and above the dark cheek area and spot. Top of head; between ears, an equal indefinite mixture of dirty white and dull black. (In *Paradoxurus philippinensis* this region is black.) Ears dull blackish on the outside and with a few dirty white hairs on the inside. Anterior third of upper parts of body, top and sides of neck, an indefinite mixture of cream buff and black, the underfur and basal 5 or 6 mm. of the hairs being blackish, the middle 5 mm. of the hairs being cream buff, and the terminal 5 mm. black. The posterior two-thirds of the upper parts and basal fourth of the tail is generally similar to the anterior portion of the upper parts, but with the cream buff replaced by buff. A fairly well-defined median blackish stripe about 7 mm. wide is found along the lower two-thirds of the back, on each side of which are seven or eight ill-defined spots in a longitudinal row. Outer surfaces of thighs and upper portions of the forelegs similar in color to the anterior third of the body. Fore and hind feet and terminal three-fourths of tail dull black or brownish black. Chin, throat, and anterior underparts and inner side of thighs and forelegs dirty white or cream buff, the blackish bases of the hairs showing through everywhere. Rest of underparts, generally dark buffy, and the dark bases of the hairs less conspicuous.

*Skull and teeth.*—The skull and teeth of *Paradoxurus canescens* are a trifle smaller than they are in specimens of *P. philippinensis* from Borneo. Many specimens of *P. hermaphroditus* from the Malay Peninsula show that there is much variation in regard to size of skull and teeth, so that the slightly smaller size of the Paradoxure from Billiton may not be specific.

*Measurements of the type.*—Head and body, 510 mm.; tail vertebrae, 385; hind foot with and without claws, 78, 75; greatest length of skull, 99.3; upper length, 90.7; basal length, 93; basilar length, 90.5; condylo-basal length, 98; palatal length, 43.7; zygomatic breadth, 57.2; breadth of brain case above roots of zygomata, 33.6; interorbital constriction, 11.1; front of canine to back of last molar (alveoli), 36; mandible, condyle to front of symphysis, 71.5; front of canine to back of last molar (alveoli), 38.6.

*Specimens examined.*—Three, all from Billiton; the type, an adult male from Tanjong Batu, an adult female from the same place, and an adult female from Bukit Menguru.

*Remarks.*—*Paradoxurus canescens* is generally lighter in color and grayer in the anterior portions than any other species I have seen. In grayness of head it is approached by *P. brunnipes* Miller, but the brown feet of the latter are distinctive. None of the other species have the distinct gray area between the ears that *P. canescens* has.

**ARCTOGALIDIA MINOR, new species.**

*Type.*—Adult female, skin and skull, Cat. No. 124984, U.S.N.M., collected at Buding Bay, island of Billiton, between Borneo and Sumatra, August 3, 1904, by Dr. W. L. Abbott. Original number, 3532.

*Diagnostic characters.*—A dwarf form of *Arctogalidia stigmatica*, similar in color and markings to *A. fusca* Miller from Pulo Kundur, but distinctly smaller.

*Color.*—Type: General color above most like Ridgway's smoke-gray; under fur and bases of hairs dark broccoli brown, subapical band on hairs, dirty white; apical ring, blackish brown. Three fairly well-defined blackish lines, 4–5 mm. wide extend along the middle of the back, from region of shoulders nearly to root of tail. Head, generally dull blackish, faintly grizzled between the eyes with buffy white. Ears blackish. Side of neck posterior to ears and in front of shoulder, buffy white. Feet blackish. Underparts generally an indefinite, dirty grayish color; in the inguinal region, clay color. Basal third of tail above and below similar to back, distal two-thirds blackish.

*Skull and teeth.*—These differ from those of related species in their smaller size. Greatest length of skull, 87.5 mm.; type of *Arctogalidia fusca*, 98.5; adult male, Cat No. 142341 U.S.N.M, from western Borneo, 110.8; greatest width of skulls, respectively, 46.7; 62.3; 67.4.

*Measurements of type.*—Head and body, 440 mm.; tail vertebræ, 435; hind foot, with and without claws, 74, 68; greatest length of skull, 87.5; upper length, 80.5; basal length, 81.5; basilar length, 79; condylo-basal length, 86; palatal length, 47.5; zygomatic breadth, 46.7; width of brain case above roots of zygomata, 30.3; interorbital constriction, 10; front of canine to back of last upper molar, 31.8; mandible, condyle to front of symphysis, 64.3; front of canine to back of last lower molar (alveoli), 34.8.

*Specimens examined.*—One, the type.

*Remarks.*—*Arctogalidia minor* needs no comparison with other species of the genus as it is at once told by its small size.

Measurements of specimens of *Paradozurus*, *Viverra*, and *Arctogalidia* from Banka and Billiton.

| Name.                               | Number.  | Sex.              | Head and body. | Tail vertebrae. | Hind foot without claws. | Hind foot with claws. | Basal length of skull. | Zygomatic breadth. | Front of canine to back of last upper molar (alveoli). |
|-------------------------------------|----------|-------------------|----------------|-----------------|--------------------------|-----------------------|------------------------|--------------------|--------------------------------------------------------|
|                                     |          |                   | mm.            | mm.             | mm.                      | mm.                   | mm.                    | mm.                | mm.                                                    |
| <i>Paradozurus hermaphroditus</i> . | 124864   | Female adult..... | 525            | 440             | 78                       | 80                    | 95.7                   | 54.2               | 36.2                                                   |
| Do.....                             | 124902   | Male adult.....   | 540            | 450             | 81                       | 85                    | 101.3                  | 65.8               | 37.4                                                   |
| <i>Paradozurus canescens</i> .....  | a 124943 | do.....           | 510            | 385             | 75                       | 78                    | 93.0                   | 57.2               | 36.0                                                   |
| Do.....                             | 124944   | Female adult..... | 480            | 370             | 70                       | 71                    | 87.6                   | 50.4               | 32.8                                                   |
| Do.....                             | 125023   | do.....           | 465            | 405             | 73                       | 76                    | 89.6                   | 50.0               | 34.8                                                   |
| <i>Viverra zangalunga</i> .....     | 124945   | do.....           | 650            | 305             | 95                       | 97                    | 107.3                  | 54.5               | 43.6                                                   |
| Do.....                             | 125025   | Male adult.....   | 620            | 300             | 103                      | 105                   | 103.7                  | 56.7               | 44.7                                                   |
| <i>Arctogalidia minor</i> .....     | a 124984 | Female adult..... | 440            | 435             | 68                       | 74                    | 81.5                   | 46.7               | 31.8                                                   |

a Type.

#### TUPAIA INFLATA, new species.

1888. *Tupaia javanica* JENTINK. Mus. d'Hist. Nat. Pays-Bas, XII, 1888, p. 117.

1890. *Tupaia javanica* JENTINK. Notes from Leyden Museum, XXII, p. 152, March, 1890.

1905. *Tupaia javanica* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 298.

*Type*.—Adult male, skin and skull, Cat. No. 124709, U.S.N.M., collected at Tanjong Rengsam, island of Banka, east of Sumatra, May 20, 1904, by Dr. W. L. Abbott. Original number, 3241.

*Diagnostic characters*.—A small member of the genus related to *malaccana*, *javanica*, and *minor*. It is larger than *malaccana* (hind foot 38 against 34) with a darker belly and obscured shoulder stripe. It is about the same size as *javanica*, but much lighter both above and below, and with longer tail. The skull is slightly larger than that of *malaccana*, decidedly shorter than that of *javanica*, and has the brain case more inflated than in either of them. In comparing *inflata* with *minor* in the British Museum, Mr. Miller noted that the skull of *inflata* is slightly greater in size, and has the brain case conspicuously deeper and more inflated than it is in *minor*.

*Color*.—Type: Upper surface of head and body a fine grizzle of black and a color between russet and tawny olive, the russet being more conspicuous anteriorly and the tawny olive posteriorly. Sides of body, outer surfaces of legs and feet similar in color to the back, but the black of the hairs not so much in evidence. Cheeks and sides of neck almost pure light russet with a slight grizzling of black. Chin, throat, anterior part of chest, inner side of forelegs and posterior part of belly, a light dull ochraceous or ochraceous-buff, darkest in the throat. Middle of the underparts has a suffused patch 25 or 30 mm. in width



formed by an extension of the colors of the sides. Inner side of hind legs grayish. Hairs of the tail, blackish, ringed with a light tawny olive above and below with conspicuous rings of grayish which is the color of the base of the hairs below.

Color of the rest of the series: Upper parts as in the type. The majority of the specimens have the underparts more grayish and less ochraceous than has the type. In all there is a suffusion of the color of the sides over the middle of the belly. Two of the specimens, Cat. No. 124985, from Billiton, and Cat. No. 124909, from Banka, have the tails in a different pelage from the others, the base of the hairs underneath being tawny ochraceous and ringed above and laterally with a slight tint of the same color.

*Skull and teeth.* The skull is distinctly smaller and with a shorter rostrum than that of *Tupaia javanica* and with more inflated brain case and bullæ. It is slightly larger than the skull of *T. malaccana* and with more inflated brain case and bullæ. The teeth of *Tupaia inflata* average a little larger than those of *T. malaccana* and a little smaller than those of *T. javanica*.

*Measurements.*—External measurements of type.<sup>a</sup> Total length, 322 mm.; head and body, 150 (155, 139); tail vertebrae, 172 (130, 146); hind foot, 38 (35, 34).

Cranial measurements of the type.—Greatest length of skull, 39 mm. (43.5, 37.5); condylo-basal length, 37 (40, 35); basal length, 34 (37, 31); palatal length, 20 (22.5, 18); zygomatic breadth, 22 (23, 21); least interorbital breadth, 13 (13.5, 12.5); breadth of brain case above roots of zygomata, 17.5 (17.5, 17); height of brain case, middle of basioccipital to top of vault of cranium, 13.5 (12, 12); breadth of palate between middle molars, 7.5 (7.5, 6.5); maxillary tooth row, exclusive of incisors (alveoli), 13 (14, 12.5); mandible, condyle to front of symphysis, 26 (28, 25); mandibular tooth row, exclusive of incisors (alveoli), 13 (14, 12.5).

*Specimens examined.*—Six skins and skulls, three from Billiton and three from Banka.

*Remarks.*—*Tupaia inflata* is apparently a well-marked form, easily distinguishable from *T. javanica* and *T. malaccana*. As noted above, Mr. Miller in comparing *T. inflata* with *T. minor* found them readily separable by cranial characters.

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<sup>a</sup> The figures in parentheses are those of an average specimen of *T. javanica* and *T. malaccana*, respectively. For measurements of the series see table page 603.

## TUPAIA DISCOLOR, new species.

1905. *Tupaia ferruginea* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 298.

*Type*.—Adult female, skin and skull, Cat. No. 124703, U.S.N.M., collected at Tanjong Rengsam, island of Banka, east of Sumatra, May 24, 1904, by Dr. W. L. Abbott. Original number, 3262.

*Diagnostic characters*.—Similar to *Tupaia ferruginea* Raffles, but lower half of back distinctly grayish, belly tawny (as in *T. chrysogaster* Miller) instead of grayish. Shoulder stripe conspicuous, bright tawny instead of grayish as in *ferruginea*. Teeth smaller, bullæ and brain case more inflated than in *ferruginea*.

*Color*.—Type: Upper parts of head, neck, anterior half of back and outer sides of forelegs has the general effect of a deep, rich hazel finely grizzled with blackish. At the middle of the back this effect passes into a grizzle of raw sienna and black, extending over the posterior half of body and outer side of hind legs. Brightest portions of the underparts (middle of belly, axillæ, and bordering sides of neck) dull tawny ochraceous gradually lightening out elsewhere into dull ochraceous buff. The conspicuous shoulder stripe, ochraceous rufous. Upper surface of tail blackish, finely and sparingly grizzled with cream buff. On the under surface of tail a dirty cream-buff predominates except along the outer edges, where the colors are the same as the upper surface. Feet blackish brown, sparingly grizzled with the light colors of the legs.

*Skull and teeth*.—Skull similar to that of *Tupaia ferruginea*, but slightly smaller, with smaller teeth, the crowns of first and second maxillary molars more nearly quadrate, bullæ distinctly larger, and brain case more inflated.

*Measurements*.—External and cranial measurements of the type:<sup>a</sup> Total length, 395 mm.; head and body, 220; tail vertebrae, 175 (collector's measurements); hind foot, 49 (from dried skin); greatest length of skull, 49.5; basal length, 44; condylo-basal length, 47; palatal length, 27; upper length, 48; zygomatic breadth, 25.5; least inter-orbital breadth, 14; breadth of brain case above roots of zygomatics, 19; breadth of palate between middle molars, 10.5; maxillary tooth row, exclusive of incisors (alveoli), 19; mandible condyle to front of symphysis, 34; mandibular tooth row, exclusive of incisors, 19.

*Specimens examined*.—Nine skins with skulls, one odd skull, and two in alcohol, collected at Tanjong Rengsam; two skins with skulls and one in alcohol from Klabat Bay.

*Remarks*.—The series of skins and skulls is very uniform. There are no noticeable individual variations; an immature individual has

<sup>a</sup> For measurements of the series see page 603.

the same color pattern as the adults. *Tupaia discolor* is apparently a very distinct species though related to *ferruginea*, but differs sharply, as mentioned above. Mr. Gerrit S. Miller, jr., who compared specimens of it with forms in the British Museum, noted that externally it is much like *hypochrysa*, but upper parts distinctly more red anteriorly and more gray posteriorly, the two regions forming a noticeable contrast of which there is none in *hypochrysa*. Underparts much lighter than in *hypochrysa*, especially on posterior half of belly and inner surface of hind legs. In *hypochrysa* the inside of hind leg is so dark that it forms no noticeable contrast with the outer side, while in *discolor* the contrast is sharp and very conspicuous. The same differences are found in both species, but to a less degree in the front legs. Shoulder stripe practically absent in *hypochrysa*, noticeable though small in *discolor*. Tail as in *hypochrysa*, but not quite as long haired, and longitudinal lines on underside less distinct. Skull and teeth noticeably smaller than in *hypochrysa*.

*External and cranial measurements of tree shrews from Banka and Billiton.*

| Name,                        | Locality.                | Number.  | Sex.      | Head and body. | Tail vertebrae. | Hind foot. | Greatest length of skull. | Zygomatic breadth. | Least interorbital width. |
|------------------------------|--------------------------|----------|-----------|----------------|-----------------|------------|---------------------------|--------------------|---------------------------|
|                              |                          |          |           | mm.            | mm.             | mm.        | mm.                       | mm.                | mm.                       |
| <i>Tupaia discolor</i> ..... | Banka, Tanjong Rengsam.  | a124697  | Male .... | 195            | 167             | 48         | .....                     | .....              | .....                     |
| Do.....                      | do.....                  | a124698  | Female..  | 235            | 174             | 47         | .....                     | .....              | .....                     |
| Do.....                      | do.....                  | b124699  | do.....   | 210            | 175             | 47         | 50.0                      | 25.0               | 14.0                      |
| Do.....                      | do.....                  | b124700  | Male .... | 203            | 177             | 49         | 49.0                      | 25.0               | 13.5                      |
| Do.....                      | do.....                  | b124701  | do.....   | 205            | 187             | 51         | 50.0                      | 26.0               | 14.0                      |
| Do.....                      | do.....                  | b124702  | do.....   | 200            | .....           | 49         | 50.0                      | 25.5               | 14.0                      |
| Do.....                      | do.....                  | cb124703 | Female..  | 220            | 175             | 49         | 49.5                      | 25.5               | 14.0                      |
| Do.....                      | do.....                  | b124704  | do.....   | 203            | 180             | 50         | 49.5                      | 25.0               | 14.0                      |
| Do.....                      | do.....                  | b124705  | Male .... | 203            | 187             | 49         | 49.0                      | 25.0               | 13.5                      |
| Do.....                      | do.....                  | b124706  | do.....   | 200            | 180             | 49         | 50.0                      | 25.5               | 14.0                      |
| Do.....                      | do.....                  | b124707  | Female..  | 192            | 170             | 47         | 49.0                      | 24.5               | 14.0                      |
| Do.....                      | do.....                  | d124708  | do.....   | .....          | .....           | 49.5       | 25.0                      | 14.0               | .....                     |
| Do.....                      | Banka, Klabat Bay        | br124903 | do.....   | 170            | 155             | 49         | 45.0                      | 24.0               | 13.0                      |
| Do.....                      | do.....                  | b124904  | do.....   | 210            | 162             | 48         | 50.5                      | 25.5               | 14.0                      |
| Do.....                      | do.....                  | a124905  | Male .... | 196            | .....           | 47         | .....                     | .....              | .....                     |
| <i>Tupaia inflata</i> .....  | Billiton, Tanjong Batu   | b124946  | do.....   | 140            | 165             | 40         | 39.0                      | 21.0               | 12.0                      |
| Do.....                      | do.....                  | b124947  | do.....   | 140            | 170             | 38         | 38.0                      | 21.0               | 12.0                      |
| Do.....                      | Billiton, Buding Bay     | b124985  | do.....   | 130            | 168             | 40         | 37.0                      | 20.0               | 12.5                      |
| Do.....                      | Banka, Tanjong Rengsam.  | bc124709 | do.....   | 150            | 172             | 38         | 39.0                      | 22.0               | 13.0                      |
| Do.....                      | Banka, Tanjong Mengkudu. | b124909  | do.....   | 140            | 175             | 38         | 39.0                      | 21.0               | 12.5                      |
| Do.....                      | do.....                  | b124910  | Female..  | 140            | 162             | 37         | 38.0                      | 21.0               | 12.0                      |

a Alcoholic.

b Skin and skull.

c Type.

d Skull only.

e Young.

### CYNOPTERUS BRACHYOTIS (Müller).

Seven specimens from Banka and eighteen from Billiton. I can find no differences between these and specimens of *Cynopterus brachyotis* from Borneo, the type locality. (See table of measurements, page 604.)

Measurements of *Cynopterus brachyotis* from Billiton, Banka, and Borneo.

| Name.                          | Locality. | Number. | Sex.          | Ear from crown. | Tail. | Forearm. | Second finger. | Third finger. | Fourth finger. | Fifth finger. | Tibia. | Foot. |
|--------------------------------|-----------|---------|---------------|-----------------|-------|----------|----------------|---------------|----------------|---------------|--------|-------|
|                                |           |         |               | mm.             | mm.   | mm.      | mm.            | mm.           | mm.            | mm.           | mm.    | mm.   |
| <i>Cynopterus brachyotis</i> . | Billiton. | 124950  | Male, adult.  | 14.0            | 7.5   | 63       | 41             | 93            | 80             | 80            | 26     | 14.0  |
| Do                             | do        | 124951  | Female, adult | 17.0            | 9.0   | 63       | 42             | 98            | 80             | 80            | 25     | 13.0  |
| Do                             | do        | 124952  | do            | 15.0            | 6.0   | 60       | 38             | 92            | 76             | 77            | 24     | 13.0  |
| Do                             | do        | 124953  | do            | 15.0            | 6.0   | 61       | 40             | 96            | 80             | 77            | 25     | 13.0  |
| Do                             | do        | 124954  | do            | 14.0            | 6.0   | 63       | 42             | 92            | 79             | 80            | 24     | 13.0  |
| Do                             | do        | 124955  | do            | 15.0            | 6.0   | 62       | 43             | 95            | 78             | 78            | 26     | 14.0  |
| Do                             | do        | 124956  | do            | 15.0            | 6.5   | 64       | 43             | 100           | 81             | 83            | 26     | 14.0  |
| Do                             | do        | 124957  | do            | 16.0            | 7.0   | 62       | 44             | 100           | 86             | 83            | 25     | 12.0  |
| Do                             | do        | 124958  | do            | 14.0            | 7.0   | 62       | 41             | 92            | 81             | 77            | 23     | 13.0  |
| Do                             | do        | 124959  | do            | 17.0            | 7.5   | 60       | 40             | 93            | 77             | 80            | 24     | 14.0  |
| Do                             | Banka     | 124722  | do            | 15.0            | 8.5   | 63       | 45             | 97            | 78             | 81            | 24     | 13.0  |
| Do                             | do        | 124724  | do            | 17.0            | 5.0   | 66       | 43             | 98            | 87             | 85            | 27     | 14.0  |
| Do                             | Borneo    | 142382  | Male, adult.  | 13.0            | 6.5   | 60       | 40             | 91            | 79             | 76            | 25     | 13.0  |
| Do                             | do        | 142383  | do            | 15.0            | 9.0   | 60       | 44             | 97            | 78             | 76            | 25     | 14.0  |
| Do                             | do        | 142362  | Female, adult | 17.0            | 9.0   | 66       | 45             | 104           | 88             | 85            | 27     | 16.0  |
| Do                             | do        | 142366  | do            | 15.0            | 7.0   | 62       | 43             | 97            | 82             | 81            | 25     | 13.5  |
| Do                             | do        | 142369  | do            | 14.5            | 7.0   | 63       | 41             | 96            | 84             | 82            | 26     | 16.0  |
| Do                             | do        | 142371  | do            | 14.0            | 7.5   | 64       | 41             | 94            | 78             | 78            | 25     | 13.0  |

## RHINOLOPHUS SOLITARIUS Andersen.

1905. *Rhinolophus solitarius* ANDERSEN, Ann. and Mag. Nat. Hist., 7th ser., XVI, August, 1905, p. 250.

One specimen of a *Rhinolophus* secured by Doctor Abbott at Tanjong Pamuja, Banka, has been made the type of this species by Dr. Knud Andersen. In his diagnosis it is said to be "allied to *Rh. trifolius* [found on Borneo, Malay Peninsula, Java], but slightly smaller and with very short tail and tibia. Forearm 46.5 mm."

No bat of this genus was collected by Doctor Abbott on Billiton. Jentink<sup>a</sup> records one specimen of *Rhinolophus trifolius* from that island.

## HIPPOSIDEROS GALERITUS (Cantor.)

A large series of this bat in formalin was collected by Doctor Abbott on Banka. They have been kindly identified as this species by Dr. Knud Andersen, who has compared the alcoholics and skulls with the type of *Hipposideros galeritus* and other species of the *galeritus* section of the genus. Dr. Andersen gives the following maximum and minimum measurements: 12 adult males: forearm, 50.3-48.3 mm.; metacarpal, third digit, 38-34.7; first phalanx, third digit, 17.5-15.2; second phalanx, third digit, 17.8-15; tail, 28-23; lower leg, 19.2-18; 7 adult females: forearm, 51.5-50 mm.; metacarpal, third digit, 39-35.2; first phalanx, third digit, 17-16; second phalanx, third digit, 17-16.7; tail, 29.5-26; lower leg, 19-18.2.

No bats of this genus were taken on the island of Billiton, and none are recorded from there by Jentink.

<sup>a</sup> Notes from Leyden Museum, XII, 1890, p. 152.



## EMBALLONURA PENINSULARIS Miller.

1890. *Emballonura semicaudata* JENTINK, Notes Leyden Museum, XII, 1890, p. 154.

1905. *Emballonura semicaudata* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 284 (Billiton).

Two specimens from Tanjong Bedaan, Banka, and three from Tanjong Poetak, Billiton. Cat. Nos. 124746 male and 124747 female, U.S.N.M., Banka, measure, respectively: forearm, 44, 42; second finger, 36, 36; third finger, 65, 66; fourth finger, 47, 46; fifth finger, 42, 45; tibia, 15.5, 16; foot, 7.4, 6.5; tail, 12, 11. Cat. No. 124998, U.S.N.M., male, No. 124999 female, No. 125000 female, Billiton measure, respectively; forearm, 42, —, 44; second finger, 35, 36, 38; third finger, 60, 67, 67; fourth finger, 44, 46, 48; fifth finger, 40, 45, 46; tibia, 16.7, 17.5, 17.5; foot, 8, 7.6, 7.5; tail, 10, 11, 12.

## MYOTIS CARIMATÆ Miller.

Four specimens of a *Myotis*, none of them fully adult, taken on the small island of Mendanau, just west of Billiton show no appreciable differences from *Myotis carimatæ* Miller of the Karimata Islands off the west coast of Borneo.

## NYCTICEBUS BANCANUS Lyon.

1905. *Nycticebus tardigradus* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 181.

1906. *Nycticebus bancanus* LYON, Proc. U. S. Nat. Mus., XXXI p. 536.

A specimen of a slow lemur was secured by Doctor Abbott at Klabat Bay, Banka. It is related to, but distinct from the Bornean *Nycticebus*. For measurements of this and related species see table page 537 of this volume.

## TARSIUS TARSIER (Erxleben).

1905. *Tarsius spectrum* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 179 (Banka, Billiton).

One specimen, an adult female, was taken at Buding Bay, Billiton. The lower back, rump, and outer surface of fore and hind legs is generally similar to Ridgway's ochraceous-buff; general color of back of head and upper back an indefinite buffy gray or light brownish (can not be matched in Ridgway); face and an ill-defined band across shoulders, ochraceous or tawny-ochraceous. "Iris pale grayish brown, tail dull reddish brown, paler beneath at base; palmar and solar pads, very pale brownish fleshy."

*Measurements*.—Head and body, 133 mm.; tail, 228; hind foot, 68; greatest length of skull, 37; basal length, 26.8; greatest width of skull, 33.5; interorbital constriction, 2.4; front of middle incisor to back outer angle of last upper molar, 16.5.

It is not at all probable that this specimen is true *Tarsius tarsier*, but without more material and especially without examples from Java, which is probably the type locality, it is impossible to determine its status.

It is apparently very different from *Tarsius bancanus* Horsfield,<sup>a</sup> which is distinct enough to constitute another genus if Horsfield's description and figures of the teeth represent a normal specimen. Doctor Abbott failed to secure any Tarsiers on Banka.

#### MACACA PHÆURA (Miller).

*Macaens cynomolgus* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 175.

Two Macaques were shot on Banka and two on Billiton, which do not differ essentially from *Macaca phæura* Miller of Nias Island. They are a little darker in color than most of the Nias specimens, but one of the latter is almost an exact match for the Banka-Billiton skins. I can see no real differences in the skulls. The majority of the Nias specimens have slightly larger feet and weigh a little more than the Banka-Billiton ones, but these differences are well within the limits of individual variation. (See table of measurements of *M. phæura*, page 606.)

#### Measurements of *Macaca phæura*.

| Locality.                    | Number. | Sex.    | Age.            | Head and body. | Tail.   | Hind foot. | Weight in grams. | Weight in pounds. |
|------------------------------|---------|---------|-----------------|----------------|---------|------------|------------------|-------------------|
| Billiton: Tanjong Batu.....  | 124969  | Male    | Old adult...    | mm. 485        | mm. 480 | mm. 122    | gms. 4,536       | lbs. 10           |
| Do .....                     | 124970  | do      | Adult .....     | 450            | 445     | 118        | 4,423            | 9 3/4             |
| Banka: Tanjong Rengsam ..... | 124710  | do      | Old adult ..... | 442            | 435     | 119        | 4,536            | 10                |
| Banka: Tanjong Pamuja .....  | 124863  | do      | do .....        | 435            | 520     | 122        | 5,330            | 11 1/4            |
| Nias: Siaba Bay .....        | 121868  | do      | Adult .....     | 430            | 490     | 122        | 5,103            | 11 1/4            |
| Do .....                     | 121869  | Female. | do .....        | 385            | 400     | 110        | 2,948            | 6 1/2             |
| Do .....                     | 121870  | Male    | do .....        | 460            | 480     | 130        | 4,990            | 11                |
| Do .....                     | 121871  | do      | Old adult ..... | 450            | 500     | 128        | 4,876            | 10 3/4            |
| Nias: Samasama .....         | 141371  | do      | do .....        | 490            | 560     | 140        | 5,443            | 12                |
| Nias: Lafau .....            | 141372  | do      | Adult .....     | 475            | 515     | 138        | 5,897            | 13                |

<sup>a</sup>Type.

#### Measurements of *Presbytis cristata*.

| Locality.                    | Number. | Sex.    | Age.        | Head and body. | Tail.   | Hind foot. | Weight in grams. | Weight in pounds. |
|------------------------------|---------|---------|-------------|----------------|---------|------------|------------------|-------------------|
| Billiton: Tanjong Batu ..... | 124971  | Female. | Adult ..... | mm. 470        | mm. 655 | mm. 140    | gms. 6,350       | 14                |
| Banka: Tanjong Rengsam ..... | 124711  | do      | do .....    | 460            | 680     | 135        | 5,783            | 12 3/4            |
| Do .....                     | 124712  | do      | do .....    | 495            | 645     | 135        | 6,010            | 13 1/4            |
| Do .....                     | 124713  | do      | do .....    | 510            | 650     | 142        | 6,464            | 14 1/4            |
| Banka: Tanjong Tedong .....  | 124725  | Male    | do .....    | 545            | 735     | 150        | 8,164            | 18                |

<sup>a</sup>Zoological Researches in Java, 1824, description, plate of entire animal and figures of teeth "G" on a second plate. (Pages and plates are not numbered.)

## PRESBYTIS CRISTATA (Raffles).

1905. *Semnopithecus pruinosus* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 170.

Four specimens from Banka and one from Billiton. They differ in no essential respects from specimens from Sumatra. The light colored subapical rings in three of the five skins are less conspicuous than they are in Sumatran examples. (For table of measurements see page 606.)

## NOTES BY DOCTOR ABBOTT ON HIS COLLECTING STATIONS.

(See Map, page 577.)

## BANKA.

*Tanjong Rengsam*.—May 20 to 28, 1904. The coast at Tanjong Rengsam is rather flat, with low hills in the interior. The neighborhood is mostly covered with secondary jungle and patches of lalang grass. There is one piece of heavy forest on the seashore, covering about 1 square mile, which has been preserved by the Bankanese for the sake of the timber. Some small plantations of cocoanuts are on the shore. Only four or five families live here. At the mouth of the Jering River, 3 miles away, is the large kampong [village] of Nyor. The natives are all Bankanese.

*Tanjong Tedong*.—May 31 to June 4, 1904. At Tanjong Tedong is a bluff extending along the seashore. Most of the neighborhood is covered with secondary jungle, the swampy land only being covered with heavy forest. The small kampong of Tanjong Tedong lies on the shores of the strait opposite Pulo Nangka Besar [not shown on the map]. The inhabitants are Bankanese.

*Tanjong Bedaan and Parmissan*.—June 6 to 15, 1904. Tanjong Bedaan (Bedaan on the charts) is a rocky point, the neighborhood mostly covered with secondary jungle, much of it old. A good deal of tin mining is carried on in the neighborhood. The large kampong (100 houses) of Parmassan (or Parmissan) lies about a mile inland, in a northeast direction. Bukit Parmissan is a range of hills, 5 or 6 miles long, lying 2 or 3 miles back from the sea. Its highest point is 1,600 feet, and is the second highest peak in Banka. The lower slopes of Parmissan Hill are covered with small jungle or dense scrub, at least the parts nearest the kampong, but the upper parts are covered with high open forest. Kampong Parmissan is inhabited by Sumatran Malays. Most of the parits, or tin diggings, are situated on the seashore, and a number of Chinamen live there.

*Tanjong Pamuja*.—June 17 to 21, 1904. Doctor Abbott made no special notes on this place. His account of the north shore of Banka is under Klabat Bay, below.

*Klabat Bay*.—June 22 to July 3, 1904. The north coast of Banka is fronted by broad beaches of white sand, separated by rocky points. The anchorages are not very good. It is necessary to anchor three-quarters of a mile from shore, as the holding ground is not very good in the hard sand. The coast line is thinly inhabited, and covered with forest, with a fringe of casuarinas behind the sand tracts. There are a few parits (tin diggings) a few miles inland, and on the coast during the fine season a number of Bankanese and Chinese live in temporary huts or shelters, fishing for the supply of the tin miners.

The west coast of Klabat Bay near the entrance is covered with heavy forest intersected with many paths made by woodcutters. It is mostly rolling country and dry at all seasons, a good place for collecting, but the coral reefs project so far from shore that it was a very inconvenient place for me to work. I had to anchor  $1\frac{1}{2}$  miles from shore.

The east side of Klabat Bay is inhabited and for the most part swampy or covered with secondary jungle. Many tin diggings occur not far inland. Around the head of Klabat Bay are many villages and tin diggings.

*Tanjong Mengkudu*.—July 3 to 4, 1904. Doctor Abbott made no notes on this locality. It is opposite the small Pulo Mengkudu on the map.

#### MENDANAU.

*Pulo Mendanau*.—July 14 to 15, 1904. Pulo Mendanau is about 8 by 7 geographical miles and lies west of Billiton, separated by a strait  $3\frac{1}{2}$  miles wide and 10 fathoms deep. Much of the surface is low and swampy. The highest hills are about 600 feet high. There is very little virgin forest left, the jungle being mostly scrubby secondary, and there are large tracts of lalang. Besides the animals obtained, a form of *Tragulus kanchil* is said to exist. It is not found on Billiton. No napu exist and no pigs.

#### BILLITON.

Billiton is about 43 miles square and contains about 1,600 square miles. The surface is mostly low, rolling hills, presenting a flat appearance from the sea, with isolated higher hills. The highest points are Tajem Laki and Tajem Bini, each about 1,770 feet high. The island has been largely worked for tin during the past fifty-two years, but the production of tin is now diminishing.

There is no heavy forest left upon the seacoast, but there is said to be a good deal left in the interior, especially in the south and west. I only found one small tract of virgin forest, on and around Bukit Mengúru, west of Buding Bay. The rest of the island is covered with secondary jungle and tracts of lalang (coarse grass).



There are about 9,000 Chinese miners. The native inhabitants are Malays and a "wild tribe" called "Orang Sikka," who live exclusively in their boats and do not cultivate the land, living on the produce of the reefs and sea.

Besides the animals obtained, pigs were common, in some places evidently very abundant. I had a glimpse of only one. *Tenggeling* (*Manis*) is said to exist. The *Tupai blang* (*Sciurus* "*prevostii*") is said to occur, but is rare. I did not see it.

**LIST OF MAMMALS RECORDED FROM THE ISLANDS OF  
BANKA, BILLITON, AND MENDANAU, WITH FIELD  
NOTES ON THOSE COLLECTED AND OBSERVED BY  
DOCTOR ABBOTT.**

BANKA.

*Manis javanica*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, p. 216. *Manis javanica*.—Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 269. Not taken by Doctor Abbott, but "said to be common."

*Tragulus bancanus*, p. 576.

*Tragulus luteicollis*, p. 579.

*Muntiacus bancanus*, p. 582.—"Native name Kijang."

*Rusa brookei*.—"Besides the animals obtained, I saw *Cervus equinus*, tracks only; saw some horns in possession of the natives, all very small. The Bankanese said *Rusa* and *Kijang* were numerous on Tanjong Penyusuh, but I did not go there, as it was not possible to anchor near shore." Recorded by Jentink<sup>a</sup> and by Willink<sup>b</sup> as *Rusa equina*.

*Sus oi*, p. 585.—"The only (four) pigs I got were all immature and are, I think, of one species."

*Sus vittatus* WILLINK, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 183.

*Ratufa polia bancana*, p. 587.

*Sciurus bangkanus*, p. 589.

*Sciurus tedongus*, p. 591.

*Sciuropterus aurantiacus*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, 1888, p. 6.

*Sciuropterus sagitta*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, 1888, p. 6. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 232.

*Petaurista*.—"Said to occur, but I did not meet with it." Not recorded by Jentink or Willink.

*Nannosciurus bancanus*, p. 594.—"The little *Nannosciurus* occurs locally and is then common."

*Mus firmus*, p. 594.

*Mus cremoriventer*, p. 595.

*Mus asper*, p. 595.

*Mus clabatus*, p. 596.—"Rats were scarce on Banka."

*Viverra tangalunga*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 90. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 210. Not taken by Doctor Abbott, but in his notes it is said to occur.

*Viverricula malaccensis* Willink. Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 211.

<sup>a</sup> Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 149.

<sup>b</sup> Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, 1905, p. 190.

**Paradoxurus hermaphroditus**, p. 597.

*Lingsang lingsang*.—*Prionodon gracilis*, Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 92. *Lingsanga gracilis* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 212.

*Arctictis bidadura*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 96. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 216.

*Herpestes javanicus* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 218.

*Barangia sumatrana*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 115. Doctor Abbott mentions an otter as occurring on Banka, but saw none.

*Ursus malayanus*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 119. Doctor Abbott mentions the bear as occurring, but not meeting with it.

*Felis*.—"There is a wild cat, but I did not meet with it."

*Philocercus lowii*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, 1888, p. 118. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 300.

**Tupaia inflata**, p. 600.

**Tupaia discolor**, p. 602.

*Tupaia tana* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 296.

*Crocodyrus rosmeri*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, 1888, p. 34.

*Cynocephalus volans*.—*Galeopithecus volans*, Jentink, Mus. d'Hist. Nat. Pays-Bas, IX, Cat. Osteol. Mammifères, 1887, p. 69. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 270. "Did not get the Kubang (*Galeopithecus*), but this animal exists there."

**Emballonura peninsularis**, p. 605.

**Rhinolophus solitarius**, p. 604.—"Hanging beneath a palm leaf in heavy forest."

**Hipposideros galeritus**, p. 604.—"These bats were roosting in small caves or rather overhanging rocks upon Tanjong Pamuja. Beneath one rock was a dense mass roosting, and I obtained 63 individuals with two shots of the .32-caliber auxiliary barrel besides many more that dropped into crevices beneath and were lost."

*Pteropus edulis*.—Jentink, Mus. d'Hist. Nat. Pays-Bas, XII, Cat. Syst. Mammifères, 1888, p. 145. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 273.

**Cynopterus brachyotis**, p. 603.—"Specimens shot hanging upon a casuarina tree on seashore."

*Vespertilio brachypterus* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 288.

**Nycticebus bancanus**, p. 605.

*Tarsius bancanus*.—Horsfield, Zool. Researches in Java, 1824, *T. Spectrum*, Schlegel, Mus. d'Hist. Nat. Pays-Bas, VII, Simia, 1876, pp. 179, 333. Doctor Abbott remarks: "I failed to get the Tarsier, although all the natives knew it, which they called 'Méntaling.' They had not all seen it, and either the animal is scarce or more probably rarely seen, owing to its nocturnal habits. They said if I remained some time in Muntok (the capital) I would be sure to get them, as there was a regular demand there for them by the doctors (?) and they were brought there for sale."

**Macaca phæura**, p. 606.

*Macaca nemestrina*.—*Macacus nemestrinus* Schlegel, Mus. d'Hist. Nat. Pays-Bas, VII, Simia, 1876, p. 111. No specimens listed. Willink, Natuurkundig Tijdschrift

Nederlandsch-Indië, XLV, p. 176. "I saw only one *Macaca nemestrina*, a big male, which I fired at but did not get. I saw a few tame ones in the native kampongs, apparently like the *Broh* of Sumatra."—W. L. A.

**Presbytis cristata**, p. 607.

*Presbytis obscura*.—*Semnopithecus obscurus*, Schlegel, Mus. d'Hist. Nat. Pays-Bas, VII, Sinie, 1876, p. 49. No specimens listed.<sup>a</sup> Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, XLV, p. 168.

#### MENDANAU.

*Tragulus "kanchil."*—"Heard that a Kanchil occurs on the island."

**Sciurus mendanauus**, p. 589.—"A local race of *Sciurus prevostii* was common; specimens were shot at Kampong Petaling."

**Myotis carimataë**, p. 605.—"These bats were flying over a mangrove creek, generally skimming close to the surface of the water; flight slow."

#### BILLITON.

*Manis*.—*Manis javanica*.—Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 269. "Tenggeling (*Manis*) is said to exist." No specimens taken.

**Tragulus billitonus**, p. 578.—"A small napu is common; there is no kanchil or plandok." Jentink<sup>b</sup> doubtfully recorded *Tragulus kanchil* from Billiton, thinking that *kidang* had the same meaning as *kanchil* among the natives; but *kidang* or *kijang* refers to the *Muntiacus*.

**Muntiacus bancanus**, p. 582.—"The Kijang was common, but I did not see it. I frequently heard them barking." Doctor Abbott obtained from the natives a pair of antlers and the frontlet.

**Rusa brookei**, p. 584.—"A small Rusa is common; I only shot one female."

*Sus sp.*—Doctor Abbott failed to obtain any pigs, but remarks: "They were common, in some places evidently very abundant; I only had a glimpse of one." No pigs are recorded by Jentink or Willink.

**Ratufa polia**, p. 585.—"There were plenty of *Ratufa* at Bukit Mengûru, about 1½ miles west of Buding Bay. Local name Jiláling."

*Sciurus prevostii*.—Jentink, Notes Leyden Museum, XIII, 1891, p. 209; thought to be introduced. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, p. 240. Doctor Abbott remarks: "The Tupai blang (*Sciurus prevostii*) is said to occur, but it is rare. I did not see it. An old Malay said they occurred, but were rare, in the heavy forests of the interior of the island."

**Sciurus billitonus**, p. 592.

**Sciuropterus vordermanni**, p. 593.—"Local name Kâpôôa."

*Nannosciurus*.—"I did not meet with *Nannosciurus*, although I occasionally heard its shrill whistle. The natives all knew it." *Nannosciurus melanotis* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 249.

**Mus cremoriventer**, p. 595.—"Rats were scarce on Billiton."

**Mus neglectus**, p. 595.

**Mus asper**, p. 595.

**Viverra tangalunga**, p. 597.—"Trapped by natives."

**Paradoxurus canescens**, p. 597.—"Trapped by natives."

**Arctogalidia minor**, p. 599.—"Local name for Musang is Gáling. This animal was one of a pair passing through the tree tops one evening. They were going to feed on a wild fruit tree, where I afterwards shot this one. As this genus keeps in the tree tops, it can not be trapped as *Viverra* and *Paradoxurus* are."

<sup>a</sup> "Bleeker, enfin, m'assure avoir reçu ce singe de l'île de Bangka."

<sup>b</sup> Notes Leyden Museum, XIII, 1891, p. 209.

**Tupaia inflata**, p. 600.

*Cynocephalus volans*—*Galeopithecus volans* Willink.—Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 270.

*Pteropus edulis* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 273.

**Cynopterus brachyotis**, p. 603.

*Rhinolophus trifoliatus*.—Jentink, Notes Leyden Museum, XIII, 1891, p. 209. Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 281.

**Emballonura peninsularis**, p. 605.—“These bats were in a small cave formed by fallen rocks on the shore.”

*Myotis muricola*.—*Vespertilio muricola*, Jentink, Notes Leyden Museum, XIII, 1891, p. 209. *Myotis muricola* Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 293.

*Pipistrellus vordermanni*.—*Vesperugo vordermanni*, Jentink, Notes Leyden Museum, XIII, 1891, p. 209. *Vespertilio vordermanni*, Willink, Natuurkundig Tijdschrift Nederlandsch-Indië, LXV, 1905, p. 290.

**Tarsius tarsier**, p. 605.—“The *Tarsius* is probably common enough, but is rarely taken except when tree felling is in progress. The *Nycticebus* seems to be absent.”

**Macaca phaeura**, p. 606.

**Presbytis cristata**, p. 607.



# A REVIEW OF THE HERRING-LIKE FISHES OF JAPAN.

By DAVID STARR JORDAN and ALBERT CHRISTIAN HERRE,

*Of Stanford University, California.*

In this paper is given a descriptive list of the species of fishes related to the Clupeidæ, or herring family, known to inhabit the waters of Japan. The paper is based on the collection made in 1900, by Professors Jordan and Snyder. Series of the species named are in the United States National Museum and in the collections of Stanford University.

The Japanese herring-like fishes, *Isospondyli*, without adipose fin, belong to ten different families, most of them largely represented by extinct forms. Of all the bony fishes, these are the most ancient, and the most primitive, the families and some of the genus going back to Mesozoic times. They are connected by an unbroken series with the later ganoid forms. It is evident that, with the possible exception of *Pterothrissus*, none of these groups originated in the Japanese fauna. Each genus represented is widely distributed and as a rule but a single species of each one occurs in Japan.

## ANALYTICAL KEY TO FAMILIES.

a. (CLUPEOIDEA). Adipose fin, none.

b. Head scaleless; no barbels.

c. Dorsal fin inserted anteriorly, usually well before anal; shore fishes or river fishes, usually silvery in coloration and with the skeleton firm; air bladder well developed.

d. Gular plate present, between branches of lower jaw; mouth large, teeth present, all pointed; lateral line present; axillary scales and sheaths large.

ELOPIDÆ, I

dd. Gular plate, none.

e. Lateral line well developed.

f. Dorsal fin very long, of 55 to 65 rays, extending almost the length of the back; mouth small, inferior; skull cavernous.... PTEROTHRISSIDÆ, II

ff. Dorsal fin short, not extending the length of the back.

g. Teeth present; no accessory branchial organ; mouth small, horizontal; posterior part of tongue and roof of mouth covered with coarse paved teeth..... ALBULIDÆ, III

gg. Teeth none; an accessory branchial organ behind gill cavity.

CHANIDÆ, IV

- ee. Lateral line wanting; no gular plate.
- i. Mouth small, inferior, toothless, the maxillary simple or nearly so; stomach gizzard-like ..... DOROSOMATIDÆ, V
  - ii. Mouth moderate, terminal, the maxillary of about three pieces; stomach not gizzard-like..... CLUPEIDÆ, VI
  - iii. Mouth subinferior, very large, below the tapering, pig-like snout; maxillary very long..... ENGRAULIDÆ, VII
- cc. Dorsal fin inserted far back, opposite anal.
- j. Anal fin very long; belly sharp-edged; air bladder cellular.  
CHIROCENTRIDÆ, VIII
  - jj. Anal fin moderate, belly rounded; deep-sea fishes, of loose organization; mostly blackish in color; mouth small, with small pointed teeth; air bladder wanting .... ALEPOCEPHALIDÆ, IX
- bb. Head and body covered with spinous scales; mouth with barbels; dorsal opposite ventrals; anal short; no air bladder..... GONORHYNCHIDÆ, X

### Family I. ELOPIDÆ.

Body elongate, more or less compressed, covered with silvery, cycloid scales; head naked. Mouth broad, terminal, the lower jaw prominent. Premaxillaries not protractile, short, the maxillaries forming the lateral margins of the upper jaw; maxillary composed of about three pieces, extending backward beyond the eye; an elongate bony plate between the branches of the lower jaw; bands of villiform teeth in both jaws on the vomer, palatines, pterygoids, tongue, and base of skull; no large teeth. Eye large, with an adipose eyelid. Opercular bones thin, with expanded membranaceous borders; a scaly occipital collar. Gill membranes entirely separate, free from the isthmus. Branchiostegals numerous (29 to 35). Gill-rakers long and slender. Pseudobranchiæ present or absent. Belly not keeled nor serrated, rather broad and covered with ordinary scales. Lateral line present. Dorsal fin inserted over or behind ventrals; caudal fin forked; no adipose fin; dorsal and anal depressible into a sheath of scales; pectorals and ventrals each with a long accessory scale. Parietal bones meeting along top of head. Pyloric cœca numerous. Species few, widely distributed in the tropical seas. Numerous fossil forms are referred to this ancient group, one of the oldest among bony fishes. The species are not much valued as food, the flesh being dry and bony.

#### KEY TO GENERA.

##### MEGALOPINÆ:

- a. Pseudobranchiæ none; body oblong, covered with large scales; anal fin longer than dorsal; last ray of dorsal produced in a long filament.
- b. Dorsal fin inserted over or slightly behind ventrals ..... *Megalops*, 1

##### ELOPINÆ:

- aa. Pseudobranchiæ large; body elongate, covered with small scales; anal fin smaller than dorsal; last ray of dorsal not produced in a filament..... *Elops*, 2

## I. MEGALOPS Lacépède.

*Megalops* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 289 (*cyprinoides*).

Body compressed, covered with large scales; no pseudobranchiæ; anal fin larger than dorsal fin; last ray of dorsal produced in a long filament; insertion of dorsal over base of ventral fins. Shore fishes of the Indian region, similar to the American Tarpon, or Grande Écaille (*Tarpon atlanticus*), but reaching a much smaller size. There is perhaps but one species.

(μεγαλώψ, large-eyed.)

## I. MEGALOPS CYPRINOIDES (Broussonet).

*Clupea cyprinoides* BROUSSONET, Dec. Ichthyol., I, 1782, pl. ix (Island of Tanna, South Pacific; synonymy confused with *Tarpon atlanticus*).

*Megalops filamentosus* LACÉPÈDE, Hist. Poiss., V, 1803, pp. 289, 290, pl. xiii, fig. 3 (Fort Dauphin, Madagascar).

*Clupea thrissoides* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 424 (based primarily on *cyprinoides* of Broussonet).

*Cyprinodon cundinga* HAMILTON-BUCHANAN, Fish. Ganges, pp. 254, 383 (Ganges River).

*Megalops setipinnis* RICHARDSON, Ann. Nat. Hist., XI, p. 493.

*Megalops curtifilis* RICHARDSON, Ichth. China, 1846, p. 310 (Canton).

*Megalops indicus* CUVIER and VALENCIENNES, Poiss., XIX, p. 388, pl. cxlii, 1846 (India).

*Megalops macrophthalmus* BLEEKER, Verh. Bat. Gen., XXIV, Chiroc., 1851, p. 15 (East Indies).

*Megalops macropterus* BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 284 (East Indies).

*Megalops kundinga* BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 288 (East Indies).

*Megalops oligolepis* BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 292 (East Indies).

*Elops apalike* DAY, Fish. Malabar, p. 228 (Malabar).

*Habitat*.—East Indies and South Seas, north to China and Riu Kiu Islands.

Head  $4\frac{5}{8}$  in length; depth  $4\frac{1}{8}$ ; D. 19; A. 25; P. 15; V. 10; scales in lateral line, 37; eye  $3\frac{1}{2}$  head; snout  $4\frac{3}{4}$ ; mandible  $1\frac{1}{2}$ ; interorbital space equals snout; ventral  $1\frac{1}{4}$  in head; caudal peduncle compressed,  $2\frac{3}{8}$  in head.

Body oblong, compressed, deep; head rather small, conical; interorbital space broad, grooved and ridged; snout quite short and broad; eye large, with narrow adipose lid; mouth terminal, oblique, the lower jaw projecting; a narrow bony plate between the mandibles, attached to symphysis.

Teeth in villiform bands on both jaws, tongue, vomer, palatines. Maxillary broad and long, forming lateral part of mouth and reaching beyond posterior margin of eye; gill openings very large; gill rakers of first branchial arch longer than gill filaments, slender, rigid; those of other arches very short.

Scales large; a long pointed scale in axil of both pectorals and ventrals. Lateral line prominent, with branched tubules.

Origin of dorsal a little behind that of ventrals and midway between tip of snout and base of caudal; its upper edge concave, the last ray elongate; anal fin rather low, with concave margin, its length  $1\frac{1}{2}$  times that of dorsal; basal portion of fin scaled; caudal deeply lobed, somewhat longer than head; pectorals small, thoracic. Ventrals small, their origin about midway between origin of pectoral and that of anal.

Color, back and top of head dusky olive, other parts pale, silvery; margin of each scale of a brilliant silver; fins brownish.

This species is here described from a single small specimen obtained at Naha, in the Okinawa or Riu Kiu Islands, received from the Imperial Museum of Tokyo. It has not been hitherto recorded from Japan. It is common throughout the East Indian region, often entering streams and pools.

(*κυπρίνος*, carp; *εἶδος*, resemblance.)

## 2. ELOPS Linnæus.

*Elops* LINNÆUS, Syst. Nat., 12th ed., 1766, p. 518 (*saurus*).

*Mugilomorus* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 398 (*anna-carolina*).

*Trichonotus* RAFINESQUE, Analyse de la Nature, 1815, p. 88 (*anna-carolina*); substitute for *Mugilomorus*, considered objectionable.

Body elongate, covered with thin, small, silvery scales. Dorsal fin slightly behind ventrals, its last rays short, the fin depressible into a sheath of scales; anal fin smaller, similarly depressible; pectorals and ventrals moderate, each with a long accessory scale. Opercular bones thin, with expanded, membraneous borders; a scaly occipital collar. Lateral line straight, its tubes simple. Pseudobranchiæ present, large. Vertebrae 66 to 72. One species known, a large fish of the open sea remarkable for the development of scaly sheaths. The young are ribbon-shaped and elongate, passing through a series of changes like those seen in *Albula*.

(*ἐλοφ*, name of some sea fish; a swordfish or sturgeon; from *ελαύνω*, to drive or move.)

## 2. ELOPS SAURUS Linnæus.

*Elops saurus* LINNÆUS, Syst. Nat., 12th ed., 1766, p. 518 (Carolina).—GÜNTHER, Cat., VII, 1868, p. 470 (Cuba, Jamaica, St. Croix, South America, Cape of Good Hope, Zanzibar, Djidda, Pinang, China).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Miyako, Riu Kiu Islands).—JORDAN and EVERMANN, Fishes North and Mid. Amer., I, 1896, p. 410; Fishes of Hawaiian Islands, 1905, p. 53, fig. 8, and of most authors.

*Argentina carolina* LINNÆUS, Syst. Nat., 12th ed., 1766, p. 519 (Carolina) (on the *Harengus minor bahamensis* of Catesby).

*Argentina machnata* FORSKÅL, Descr. Anim., 1775, p. 68 (Djidda, Arabia).

*Elops machnata* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., 1902, XXV, p. 327 (Suwata, Formosa).



*Mugilomorus anna-carolina* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 398 (South Carolina).

*Elops inermis* MITCHILL, Trans. Lit. and Phil. Soc. N. Y., I, 1815, p. 445 (New York).

*Elops indicus* SWAINSON, Class. Fish., II, 1839, p. 292, (after Inagow of Russell, Fishes of Vizagapatam, II, 1803, p. 63, fig. 179, nonbinomial) (Vizagapatam).

*Elops capensis* SMITH, Zool. S. Africa, 1845, pl. VII (Cape of Good Hope).

*Elops purpurascens* RICHARDSON, Ichth. China, 1846, p. 311 (Canton).

*Habitat*.—Tropical seas generally, north to southern Japan.

Head 3.75; depth about 5; D. 25 (including 7 rudiments); A. 16; P. 18; V. 15; vertebrae 66; scales 14–96–17, counting to middle of belly; eye nearly 5 in head, and equal to snout or interorbital space; mouth a little over 1.75 in head; pectoral 1.75; ventral a little more than pectoral, less than 2; least depth of caudal peduncle 3 in head.

Body elongate, compressed; head compressed, elongate, pointed; snout short, pointed, more or less rounded above; eye rather large, with broad adipose eyelid covering most of eye, except pupil; maxillary very long, expanded backward beyond the eye, with several longitudinal ridges; teeth in broad patches or bands in the jaws, along

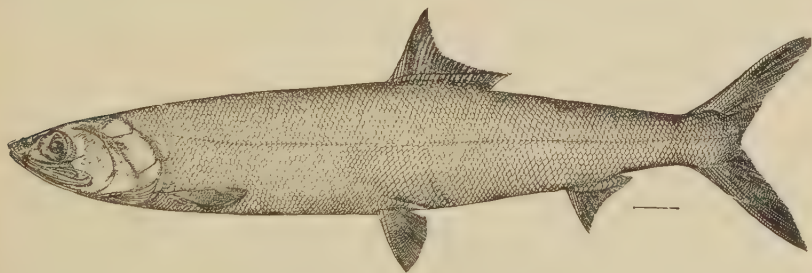


FIG. 1.—ELOPS SAURUS.

edge of maxillary and on vomer and palatines; tongue large, rather long, free in front; nostrils close together; interorbital space flattened, ridged.

Gill openings large; gill rakers 8+5 long, the outer portion more or less slightly expanded or enlarged; intestine straight, without convolutions; peritoneum silvery.

Scales small, uniform; bases of dorsal and anal with broad scaly sheaths; pectoral with scaly flap more than half length of head; ventral flap scaly, more than half length of fin; lateral line continuous; origin of dorsal nearer base of caudal than tip of snout, slightly behind base of ventrals, the anterior rays elevated; origin of anal a little behind tip of dorsal, the anterior rays longest; caudal deeply forked, lobes pointed; pectoral rather short, reaching scarcely halfway to origin of ventrals; ventrals a little shorter than pectorals, reaching more than halfway to anal.

Cosmopolitan, in the warmer seas. We have seen no specimens from Japan, but the species doubtless strays into Nagasaki, as into almost all other tropical and semitropical ports.

(σαῦρος, lizard.)

## Family II. PTEROTHRISIDÆ.

Body oblong, with rounded abdomen, covered with small cycloid scales; head narrow, oblong, naked, without barbels; muciferous channels much developed. Eye large; mouth inferior, small; margin of the upper jaw formed by the premaxillaries mesially, and by the maxillaries laterally; bands of minute teeth embedded in the thick lips; maxillary with a marginal row of very small teeth. Opercular apparatus complete. Lateral line present. No adipose fin; dorsal fin much elongate, many rayed; anal fin short; caudal fin forked, with dense layer of small scales. Stomach with a blind sac; pyloric appendages numerous. Gill apparatus well developed; pseudobranchiae present; gill openings wide. Air bladder with very thick walls, terminating in 2 short horns in front, pointed behind. Ova very small; ovaries without duct.

The family is represented by a single genus and species, occurring off the coast of Japan in rather deep water.

### 3. PTEROTHRISUS Hilgendorf.

*Pterothrissus* HILGENDORF, Leopoldina, XIII, 1877, p. 127 (*gissu*).

*Bathythrissa* GÜNTHER, Ann. Mag. Nat. Hist., p. 443, November, 1877 (*dorsalis*).

The characters of the genus are included above. Several extinct genera are referred to the neighborhood of *Pterothrissus*.

(πτερόν, wing; θρίσσα, herring.)

### 3. PTEROTHRISUS GISSU Hilgendorf.

#### GISSU.

*Pterothrissus gissu* HILGENDORF, Leopoldina, Pt. 13, 1877, p. 127 (off Tokyo).—

JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 743 (Hakodate, Japan).—JORDAN and STARKS, Bull. U. S. Fish Comm. for 1902, p. 578 (Matsushima Bay, Suruga Bay).

*Bathythrissa dorsalis* GÜNTHER, Ann. Mag. Nat. Hist., November, 1877, p. 443.—GÜNTHER, Shore Fishes, Challenger, 1880, p. 63 (Enoshima).

*Habitat*.—Coasts of Japan, in rather deep water.

Head  $4\frac{1}{2}$  in length, without caudal,  $4\frac{1}{2}$  to  $4\frac{5}{8}$  in total length; depth, about  $6\frac{1}{2}$  ( $7\frac{2}{3}$  in total length); dorsal rays about 60. Counting the first two minute spines, we find the rays in our specimens as follows: 56, 57, 57, 58, 60, 64, 65; A. 12; P. 16; V. 10; scales in lateral series about 112; eye large, prominent,  $3\frac{1}{2}$ –4 in head; snout, 3 in head; pectoral,  $1\frac{3}{4}$ ; ventral,  $2\frac{3}{4}$ ; least depth of caudal peduncle,  $4\frac{1}{2}$  to 5.

Body elongate, rather slender, the caudal peduncle markedly so: head low, large, the top broad, flattened, orbital ridges projecting above sides of interorbital space: snout long, conical, pointed, projecting considerably beyond mouth, with a median ridge above; beneath this a broad muciferous channel; a large keeled muciferous channel on side of head, extending from above mouth backward below and behind eye, there connecting with the channel on top of head: a sharp ridge running from lower lip backward almost to angle of opercle: mouth inferior, small, the short and broad maxillary reaching to a line extended vertically from the nostrils: jaws with bands of minute teeth.

Gill openings large, membranes united; gill rakers short, stout, papillate or tuberculate, present on all arches: pseudobranchiae present.

Scales small, cycloid, easily detached: head naked: caudal basally covered with fine scales.

Our numerous specimens are from Suruga Bay, Matsushima Bay, Tsugaru Straits, and Hakodate. The largest is about 14 inches long. It is found in rather deep water in abundance.

(*gisu*, the local name, also applied to species of *Sillago*, of somewhat similar form.)

### Family III. ALBULIDÆ.

Body rather elongate, little compressed, covered with rather small, brilliantly silvery scales: head naked. Snout conic, subquadrangular, shaped like the snout of a pig, and overlapping the small, inferior, horizontal mouth. Maxillary rather strong, short, with a distinct supplemental bone, slipping under the membranous edge of the very broad preorbital; premaxillaries short, not protractile. Lateral margin of upper jaw formed by the maxillaries: both jaws, vomer, and palatines with bands of villiform teeth: broad patches of coarse, blunt, paved teeth on the tongue behind and on the sphenoid and pterygoid bones. Eye large, median in head, with a bony ridge above it, and almost covered with an annular adipose eyelid. Opercle moderate, firm: preopercle with a broad, flat, membranaceous edge, which extends backward over the base of the opercle. Pseudobranchiae present. Gill rakers short, tubercle-like. Gill membranes entirely separate, free from the isthmus: branchiostegals about 14: a fold of skin across gill membranes anteriorly, its posterior free edge crenate: no gular plate. Lateral line present. Belly not carinate, flattish, covered with ordinary scales. Dorsal fin moderate, in front of ventrals, its membranes scaly; no adipose fin: anal very small: caudal widely forked. Pyloric ceca numerous. Parietal bones meeting along top of head. Vertebrae numerous,  $42+28=70$ . A single species among living fishes, found in all warm seas. In this, and probably in related families, the young pass through a metamorphosis, analogous to that seen in the conger

eels. They are for a time elongate, band shaped, with very small head and loose transparent tissues. From this condition they become gradually shorter and more compact, shrinking from 3 or  $3\frac{1}{2}$  inches in length to 2 inches. According to Doctor Gilbert, this process, like that seen in various eels, is a normal one, through which all individuals pass. In the Gulf of California, where these fishes abound, these band-shaped young are often thrown by the waves on the beach in great masses.

#### 4. ALBULA Gronow.

*Conorhyncus* NOZEMAN, Act. Select., III, 1757, p. 382 (nonbinomial).

*Albula* GRONOW, Zoöphyl., 1763, p. 102 (nonbinomial).

*Albula* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 432 (*conorhyncus*=*vulpes*).

*Butyrinus* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 45 (*banana*=*vulpes*).

*Glossodus* CUVIER, in Agassiz, Spix, Pisc. Bras., 1829, p. 48 (*forskåli*=*vulpes*).

Characters of the genus included above.

(*albus*, white.)

#### 4. ALBULA VULPES (Linnæus).

*Vubarana* MARCGRAVE, Hist. Bras., 1648, p. 154 (Brazil).

*Vulpes bahamensis* [the Bone-fish] CATESBY, Nat. Hist. Carolinas, etc., 1737, pl. II, fig. 1. (Bahamas).

*Esox vulpes* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 313 (Bahamas; based on the Bone-fish, *Vulpes bahamensis*, of Catesby).

*Argentina glossodonta* FORSKÅL, Descr. Anim., 1775, p. 68 (Djidda, Arabia).

*Macabi* PARRA, Dif. Piezas, Cuba, 1787, p. 88, pl. XXXV, fig. 1 (Cuba; based on *Vubarana* of Marcgrave).

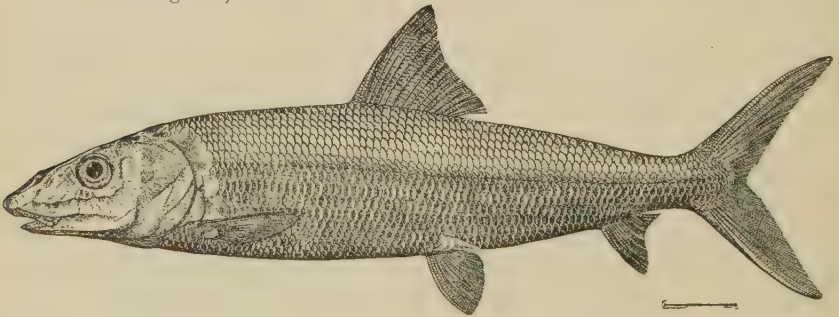


FIG. 2.—ALBULA VULPES.

*Synodus argenteus* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 398 (Asia).

*Clupea brasiliensis* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 427 (Brazil).

*Albula conorhynchus* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 432 (Antilles; after Gronow and Plumier; called *Albula plumieri* on plate LXXXVI).

*Amia immaculata* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 451 (Central America; after *Macabi* of Parra).

*Butyrinus banana* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 46 (Ile de France).

*Clupea macrocephala* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 426 (Martinique, on a drawing by Plumier).

*Glossodus forskåli* AGASSIZ, Spix, Pisc. Bras., 1829, p. 49 (Bahia; called *Engraulis sericus* and *Engraulis bahiensis* on plates XXII and XXIV).



*Albula parrae* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 339 (Martinique, Bahia, Rio de Janeiro).

*Albula goreensis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 342 (Gorea).

*Albula neoguinaica* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 350 (New Guinea).

*Albula seminuda* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 351 (New Guinea).

*Albula erythrocheilos* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 352, pl. CXL (Tonga).

*Albula forsteri* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 354 (Tahiti).

*Albula rostrata* GRONOW, Cat. Fishes, 1854, p. 189 (American ocean, etc.).

*Albula conorhynchus* GÜNTHER, Cat. VII, 1868, p. 468.

*Albula vulpes* JORDAN and GILBERT, Synopsis, 1883, p. 258.—JORDAN and EVERMANN, Fish. North Mid. Am., I, 1898, p. 411.—JORDAN and EVERMANN, Fishes of Hawaiian Islands, 1903 (1905), p. 55, fig. 9 (Honolulu, Hilo).

*Habitat*.—Shores of all tropical seas.

Head  $3\frac{3}{4}$ ; depth 4. D. 15; A. 8; scales 9–71–7. Upper lobe of caudal the longer. A broad band of peculiar, elongate, membranaceous scales along middle line of back; accessory ventral scale large. Brilliantly silvery; olivaceous above; back and sides with faint streaks along the rows of scales; fins plain; axils dusky. Length 18 inches to 3 feet. Tropical seas, on sandy coasts, almost universally distributed and generally abundant, ranging northward to Nagasaki in Japan. One specimen found in the Tokyo market.

(*vulpes*, fox.)

#### Family IV. CHANIDÆ.

Body oblong, compressed, covered with small, firm, adherent scales. Lateral line distinct. Abdomen broad and flattish. Snout depressed; mouth small, anterior, the lower jaw with a small symphyseal tubercle; no teeth; premaxillary joined to upper anterior edge of maxillary. Eye with an adipose eyelid. Gill membranes broadly united, free from the isthmus. Branchiostegals 4; pseudobranchiæ well developed; an accessory branchial organ in a cavity behind the gill cavity. Dorsal fin opposite the ventrals; anal fin shorter than dorsal. Mucous membrane of esophagus raised into a spiral fold; intestine with many convolutions. Skeleton with various peculiarities. Coloration silvery. Vertebrae about 45. Large fishes of the warmer parts of the Pacific.

#### 5. CHANOS Lacépède.

*Chanos* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 395 (*arabicus*).

*Lutodeira* (KUHL) RÜPPELL, Neue Wirbelthiere, 1835, p. 18 (*chanos*).

*Ptycholepis* GRAY, Dieffenbach's Travels in New Zealand, II, p. 218, about 1842 (*salmonæus*).

Characters of the genus included above.

• (*χάνος*, name in modern Greek, from *χάρος*, the open mouth).

## 5. CHANOS CHANOS (Forskål).

- Mugil chanos* FORSKÅL, Descript. Anim., 1775, p. 74 (Red Sea; Djidda, Arabia).  
*Lutodeira chanos* RÜPPELL, Atlas Nordl. Africa, 1828, p. 18, pl. v, fig. 1 (Red Sea).  
*Chanos chanos* KLUNZINGER, Verh. Bat. Zool. Gen., Wien, 1871, p. 605.—JORDAN and EVERMANN, Fishes North and Mid. America, I, 1896, p. 414; Fishes of Hawaiian Islands, p. 56, 1903 (1905) fig. 10, (Hawaiian Islands); Proc. U. S. Nat. Mus., XXV, 1902, p. 327 (Giran, Taihoku and Toii, Formosa).  
*Mugil salmoneus* (Forster) BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 121 (Pacific Ocean).  
*Chanos salmoneus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1846, p. 201 (Between New Caledonia and Norfolk Island).  
*Leuciscus (Ptycholepis) salmoneus* GRAY, in Dieffenbach Trav. New Zeal., II, p. 218 (New Zealand).  
*Chanos arabicus* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 396 (Arabia).  
*Cyprinus pala* CUVIER, Règne Animal, 2d ed., II, 1829, p. 276 (India) (After Russell).  
*Cyprinus tolo* CUVIER, Règne Animal, 2d ed., II, 1829, p. 276 (India).  
*Leuciscus zeylonicus* BENNETT, Proc. Comm. Zool. Soc., 1832, p. 184 (Ceylon).  
*Chanos mento* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, pp. 194-198 (Ile de France, *chloropterus* Madipolam, *nuchalis* Vizigapatam, *orientalis* Japan, and *cyprinella* Honolulu).  
*Butirinus argenteus* JERDON, Madras Journ. Lit. Sci., XV, 1849, p. 343 (Madras).  
*Butirinus maderaspatensis* JERDON, Madr. Journ. Lit. Sci., XV, 1849, p. 344 (Madras).  
*Chanos indicus* BLEEKER, Verh. Bat. Gen., XXIV, 1852, p. 11 (East Indies).

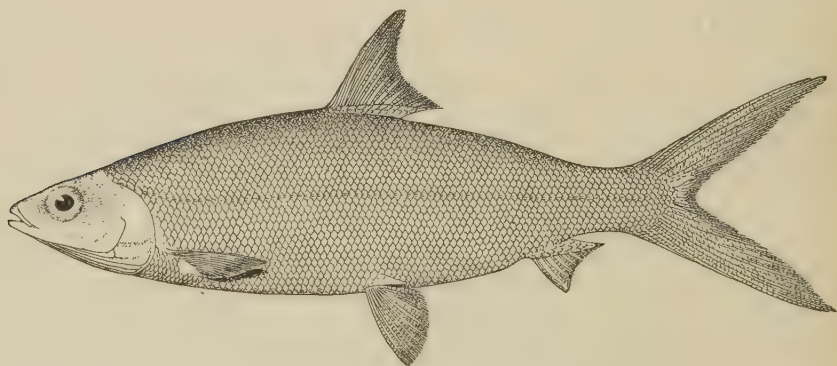


FIG. 3.—CHANOS CHANOS.

*Habitat*.—Tropical shores of the Pacific, north to southern Japan. Head  $4\frac{1}{2}$ ; depth 4. D. II, 12; A. II, 9; scales 12-86-14. Vertebrae 19+26=45; snout  $3\frac{1}{2}$ ; eye  $3\frac{1}{2}$ ; maxillary  $4\frac{1}{2}$ . Pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{1}{5}$ ; caudal  $\frac{1}{3}$  longer than head; dorsal  $1\frac{1}{4}$  in head. B. 4. Aspect of a large Cyprinoid. Body elliptical, moderately compressed, the caudal peduncle slender. Head pointed, rounded above. Eye and side of head covered by a large transparent, imperforate adipose eyelid. Mouth small, terminal toothless, transverse, the lower jaw included; maxillary broad, slipping under the adipose preorbital, without sup-

plemental bone. Opercle truncate behind. Pseudobranchiæ very large. Gill-rakers fine and flexible, very close set, rather long. Bones of gill-rakers flexible. Gill arches all connected by membrane. Lateral line well developed. Scales firm, cycloid, with strongly marked longitudinal striæ. Scales rather large, hard, firm, enameled, becoming bony when dry, used by the Indians for ornamental work. Dorsal inserted somewhat nearer snout than base of caudal, before ventrals, its first ray falcate, its last produced in a short filament, longer than pupil; base of fin with a large scaly sheath; pectoral and ventral with scaly axillary appendage; anal similar to dorsal but much smaller; pectorals and ventrals rather small; caudal very long, forked to the base, its lobes subequal, straight; base of fin with small scale; ventrals somewhat falcate. Color greenish above, the sides brilliantly silvery, fins more or less darkened; inside of ventrals and pectorals blackish. Length 2 to 5 feet. Pacific and Indian oceans, on sandy shores, north to the Hawaiian Islands and to Nagasaki; not seen by us in Japan, but almost everywhere common in the tropical Pacific.

#### Family V. DOROSOMATIDÆ.

Body short and deep, strongly compressed, covered with thin, deciduous, cycloid scales. Belly compressed to an edge, which is armed with bony serratures. Head naked, short, rather small. Mouth small, inferior, oblique, overlapped by the blunt snout; no teeth; maxillary narrow and short, with a single supplemental bone, not extending to opposite middle of eye, and forming but a small portion of lateral margin of upper jaw; mandible short and deep, its rami enlarged at base; premaxillaries not protractile. Gill-rakers slender, exceedingly numerous, not very long, similar on all the arches. Gill membranes not united, free from the isthmus; branchiostegals about 6; pseudobranchiæ large. An adipose eyelid. No lateral line. Dorsal fin about midway of the body, usually behind ventrals. Pectorals and ventrals moderate, each with an accessory scale. Anal very long and low; caudal forked. No adipose fin. Vertebrae 49. Stomach short, muscular, like the gizzard of a fowl. Mud-eating fishes of the coasts and rivers of warm regions, of little value as food. The family is very close to the Clupeidæ, the distinguishing characters being not of great importance.

#### KEY TO GENERA.

- a. Dorsal fin with its last ray prolonged and filamentous.  
 b. Mouth large; gillrakers very long; anal fin very low..... *Konosirus*, 6

## 6. KONOSIRUS Jordan and Snyder.

*Konosirus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 349 (*punctatus*).

This genus is closely related to *Dorosoma*, the American Gizzard Shad, differing in the larger mouth, longer gill-rakers, and in the very low anal fin.

The dorsal, as in *Dorosoma*, has its last ray produced in a long filament. Species Asiatic, entering rivers.

(*Konoshiro*, the Japanese name, from the Castle of Konoshiro, *kono*, virtue; *shiro*, castle; in allusion to the barred markings, like the castle gates.)

## KEY TO SPECIES.

- a. Snout little longer than lower jaw; depth about  $3\frac{1}{3}$  in length, without caudal; anal rays 22 to 24; scales 55; a dark opercular spot and dark streaks along the rows of scales above ..... *punctatus*, 6  
 aa. Snout very prominent, projecting much beyond lower jaw; depth  $2\frac{1}{3}$  in length, without caudal; anal rays 20 to 22; scales 50; color silvery, with a dark opercular spot; bluish above; rows of spots along sides of back indistinct or wanting ..... *nasus*, 7

## 6. KONOSIRUS PUNCTATUS (Schlegel) Jordan and Snyder.

## KONOSHIRO.

*Chatoëssus punctatus* SCHLEGEL, Fauna Jap. Poiss., 1846 p. 240, pl. cix, fig. 1 (Nagasaki).—CUVIER and VALENCIENNES, Hist. Nat. Poiss., XXI, 1848, p. 107 (Japan).—BLEEKER, Verh. Bat. Gen., XXV, Japan, p. 50.—KNER, Novara Fische, 1867, p. 336 (Madras, Tahiti).—GÜNTHER, Cat. Fish., VII, 1868, p. 408.—NAMIYE, Class. Cat., 1881, p. 109 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 9 (Tokyo; Boshu, Japan).

*Konosirus punctatus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 327 (Tokyo); Check list, 1901, p. 52 (Yokohama).

*Clupanodon thrissa* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 743 (Yokohama; not *Clupea thrissa* of Osbeck, a Chinese species).

*Habitat*.—Shores of southern Japan, entering estuaries.

Head 4 in length ( $4\frac{2}{3}$  in total length); depth  $3\frac{1}{4}$  ( $3\frac{3}{8}$ ); D. 16. A. 23; P. 16; V. 8; scales in lateral series, 55; eye space 4 in head; eye 6; interorbital space  $4\frac{1}{2}$  in head; mandible  $2\frac{2}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $2\frac{1}{2}$ ; caudal peduncle compressed, about 3.

Body deep compressed, elliptical ovate: the belly more curved than back; body less elevated than in species of *Dorosoma*; throat and belly sharp, margined by scutes terminating in sharp spines which point backward; head rather small, conical, rather broad above, the interorbital space with a blunt median ridge; snout blunt, quite short, broad; eye space large, pointed anteriorly, all but pupil of eye covered by an adipose lid; mouth subterminal, slightly inferior, the premaxillaries projecting slightly beyond cleft, medium size, larger than in the American species, *Dorosoma cepedianum*; mandible extending to posterior margin of eye space; maxillary well developed posteriorly, reaching to middle of orbit; opercular membrane bones broad, well



developed; numerous branching mucous canals radiating behind and below eye.

Teeth none.

Gill-openings large, membranes free from isthmus; gillrakers of first arch very fine and slender, as long as gill filaments, which are coarser and stouter than rakers; all the gill arches with well developed gillrakers; pseudobranchiæ numerous, coarse.

Scales thin, close set, not deciduous, medium size, cycloid; a long, narrow, pointed scale in axil of ventral and pectoral.

Lateral line not present.

Distance from tip of snout to base of dorsal a trifle more than from posterior end of dorsal to middle of base of caudal; fin moderately high forward, rapidly decreasing in height till last ray is reached; this is filamentous and greatly elongated, reaching base of caudal; anal fin low, slightly longer than dorsal; caudal of medium size, deeply emarginate; pectoral moderate; ventral small, its origin beneath middle of dorsal.

Color dorsal region brownish olive, with a silvery cast; each scale on back and to middle of sides with a brown spot in middle; a large black blotch on shoulder, opposite or higher than eye; sides and belly yellowish silvery; fins uniform, pale brown or yellowish.

This description is taken from specimens from Tokyo. We have others from Nagasaki, and from Matsushima Bay. It is rather common in southern Japan.

The related species (*Konosirus thrissa* Osbeck and *Konosirus nasus* (Bloch) = *Chatoessus aquosus* Richardson) occurs in southern China, but there is no trustworthy record of their existence in Japan. It is not known that *Konosirus punctatus* occurs in China.

(*punctatus*, spotted.)

## 7. KONOSIRUS NASUS (Bloch).

### DOROKUI (MUD CARP).

*Clupea nasus* BLOCH, Ichthyologia, XII, 1797, p. 117, pl. ccccxix (Tranquebar).

*Chatoessus nasus* CUVIER and VALENCIENNES, Poiss., XXI, 1848, p. 104 (Pondicherry, Bombay).—GÜNTHER, Cat., VII, 1868, p. 407 (Cochin, Java, Amboyna, Philippines).

*Dorosoma nasus* BLEEKER, Atlas Ichth. Clup., VI, p. 142; pl. cclx, fig. 4 (East Indies).

*Konosirus nasus* SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 462 (Urado near Kochi).

*Clupanodon nasicus* LACÉPÈDE, Poiss., V, 1803, p. 472 (After Bloch).

*Chatoessus altus* GRAY, Illustr. Ind. Zool., 1835, pl. xci, fig. 2 (India).

*Chatoessus aquosus* RICHARDSON, Ichth. China, 1846 (Canton).

*Chatoessus come* RICHARDSON, Voy. Erebus and Terror, 1846, p. 62, pl. xxxi.

*Konosirus thrissa* JORDAN and SEALE, Proc. Davenport Ac. Sci., X, 1905, p. 2 (Hong Kong; not *Clupea thrissa* Linnaeus).<sup>a</sup>

<sup>a</sup>The name *Clupea thrissa* Linnæus, based primarily on the *Clupea triza* of Lagerström and *Clupea thrissa* of Osbeck, seems to belong to the remaining Chinese species, distinguished by the long anal fin (A. 26 to 28). This should stand as

*Habitat*.—East Indies, north to southern Japan.

Head 4; depth  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; D. 16, A. 20–22 (besides two rudiments); scales 19–46 to 50; eye 4 in head, about as long as snout; gape twice as wide as deep, overhung by the snout; gill rakers rather short; abdominal scutes 15+13.

Silvery, bluish above, the middle of each row of scales above darker, this forming faint longitudinal streaks above; usually a blackish spot behind opercle; dorsal and caudal dusky behind.

This species, common on the coasts of China and south to India and the East Indies, has been once taken in Japan, three specimens being secured at Urado near Kochi in Shikoku by Dr. Hugh M. Smith.

Jordan and Seale were apparently in error in the identification of this species with *Clupea thrissa* Linnaeus. In the original diagnosis, quoted from Lagerström, 28 anal rays are counted. This number occurs in the Chinese species, *Konosirus maculatus* (Richardson), which species should stand as *Konosirus thrissa*. The *thrissa* of Lacepede, after Broussonet, the type of his genus *Clupanodon*, is the West Indian *Opisthonema*, or rather *Clupanodon oglinus*.

(*nasus*, nose.)

## Family VI. CLUPEIDÆ.

### HERRINGS.

Body oblong or elongate, more or less compressed, covered with cycloid or pectinated scales. Belly sometimes rounded, sometimes compressed, in which case it is often armed with bony serratures. Head naked, usually compressed. Mouth rather large, terminal, the jaws about equal; maxillaries forming the lateral margins of the upper jaw, each composed of about three pieces. Premaxillaries not protractile; teeth mostly small, often feeble or wanting, variously arranged. Adipose eyelid present or absent. Gillrakers long and slender; gill membranes not connected, free from the isthmus. No gular plate. Gills 4, a slit behind the fourth. Branchiostegals usually few (6 to 15). Posterior lower part of opercular region often with an angular emargination, the tips of the larger branchiostegals being abruptly truncate. Pseudobranchiæ present. No lateral line. Dorsal fin

### KONOSIRUS THRISSE (Linnæus).

*Mystus corpore ovato* (*Clupea triza*) LAGERSTRÖM, China, about 1750, p. 30 (China; A. 28).

*Clupea thrissa* OSBECK, Iter. Chinensis, 1757, p. 257 (China; A. 24; pre-Linnæan).

*Clupea thrissa* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 318. (Diagnosis after Lagerström; name after Osbeck).

*Chatoëssus osbecki* CUVIER and VALENCIENNES, Poiss., XXI, 1848, p. 106 (China; snout much shorter than in *C. nasus*; body more oblong; A. 24; may be *K. punctatus*).

*Chatoëssus triza*, *chrysopterus*, and *maculatus*, RICHARDSON, Ichth. China, pp. 307, 308 (Canton).

*Chatoëssus maculatus* GÜNTHER, Cat. VII, 1868, p. 409 (Formosa).

median or somewhat posterior, rarely wanting. No adipose fin. Ventrals moderate or small (wanting in *Pristigaster*). Anal usually rather long; caudal fin forked. Vertebrae 40 to 56. Species numerous, inhabiting all seas, and usually swimming in immense schools; many species ascend fresh waters, and some remain there permanently. The northern and fresh-water species, as in many other families, differ from the tropical forms in having a larger number of vertebral segments.

## KEY TO GENERA.

- a. (DUSSUMIERIINÆ.) Belly rounded, covered with ordinary scales; supplemental bones of maxillary very narrow; anal fin short.
- b. Ventrals small; teeth small, persistent, on jaws, vomer, palatines, pterygoids, and tongue.
- c. Dorsal inserted before ventrals; teeth moderate; no silvery lateral band; dorsal long, of 18 to 29 developed rays..... *Etrumeus*, 7
- cc. Dorsal opposite ventrals; teeth very feeble or wanting; a broad silvery lateral stripe ..... *Stolephorus*, 8
- aa. Belly compressed, armed with bony serræ; supplemental bones of maxillary broad.
- d. (CLUPEINÆ) Anal fin moderate, of 15 to 25 rays; dorsal inserted nearly opposite ventrals.
- e. Scales with their posterior margins entire and rounded; intestinal canal of moderate length.
- f. Last ray of dorsal not produced.
- g. Vertebrae about 50 in number (46 to 56); species of northern regions.
- h. Vomer with teeth; ventral scutes weak, ventrals below middle of dorsal; vertebrae 50 to 56. Skeleton rather firm.... *Clupea*, 9
- hh. Vomer without teeth; ventral scutes very weak, the belly more or less rounded; vertebrae about 52; ventrals under middle of dorsal. Skeleton weak, flesh oily..... *Sardinella*, 10
- gg. Vertebrae about 42 (40 to 44); tropical species with the scales large and usually firmly attached; ventrals inserted under middle of dorsal; adipose eyelid obsolete..... *Harengula*, 11
- dd. (PRISTIGASTERINÆ.) Anal fin very long, of more than 30 rays; dorsal fin inserted behind ventrals.
- ii. Teeth all villiform; no canines; ventral fins present. *Ilisha*, 12

## 7. ETRUMEUS Bleeker.

*Etrumeus* BLEEKER, Verh. Bat. Gen., XXV, Japan, 1853, p. 58 (*micropus*).

*Perkinsia* ROSA SMITH, Amer. Nat., 1891, p. 153 (*othonops*).

Body rather elongate, somewhat compressed, the abdomen rounded and without serratures. Mouth terminal, of moderate width, formed as in *Clupea*, but the maxillary more slender. Teeth moderate, in patches on jaws, palatines, pterygoids, and tongue. Scales cycloid, entire, very deciduous. Branchiostegals numerous, very slender. Ventrals inserted posteriorly, entirely behind dorsal; the dorsal fin rather long, of 18 to 20 rays; anal low, of moderate length. Pseudo-branchiæ well developed; pyloric cæca numerous. No silvery lateral stripe. Few species. Asiatic and American.

(*urume*, Japanese name of *Etrumeus micropus*, called by Bleeker *Ikan etrumei*.)

## 8. ETRUMEUS MICROPUS (Schlegel).

## URUMEIWASHI.

*Clupea micropus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 236, pl. cvii, fig. 2 (Nagasaki).

*Etrumeus micropus* BLEEKER, Verh. Bat. Gen., XXV, 1853, p. 48 (Nagasaki).—GÜNTHER, Cat., VII, 1868, p. 467 (Japan).—NAMIYE, Class. Cat., 1881, p. 109 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo).—JORDAN and EVERMANN, Bull. U. S. Fish Com., XXIII for 1903, p. 58 (Honolulu).

*Perkinsia othonops* ROSA SMITH EIGENMANN, Amer. Nat., 1891, p. 153 (San Diego, California).

*Habitat*.—Sandy shores of southern Japan; also ranging to Hawaii, and once recorded from California.

Head 4 to  $4\frac{3}{8}$  in length; depth 6 to  $6\frac{1}{2}$ ; D. 20; A. 11; P. 16 or 17; V. 9; scales about 56; eye 3 in head; snout 3.5; mandibles 2; inter-orbital space 4 to  $4\frac{1}{2}$ ; maxillary  $2\frac{3}{4}$  to 3; P. 1.5 in head; V.  $2\frac{3}{4}$ ; caudal peduncle compressed, its least depth  $3\frac{1}{4}$  in head.

Body elongate, subcylindrical, slightly compressed; head elongate, much compressed anteriorly, pointed, flattened above; snout long, pointed, compressed; eyes large, covered by thick, adipose eyelids; mouth small, terminal, jaws subequal, the mandible projecting very slightly; teeth in jaws minute; in fine villiform bands on vomer, palatines, and tongue. Maxillary slipping under the preorbital ridge and extending posteriorly a little beyond the anterior edge of eye; preopercle with radiated branching mucous caudals present; gill openings large, membranes free from isthmus; gill rakers long, slender; gill filaments longer, fine, the pseudobranchiae also long; peritoneum pale or silvery; scales rather large, cycloid, mostly falling off in alcoholic specimens; both pectorals and ventrals with long pointed scaly flaps but little shorter than the fins. Origin of dorsal nearer tip of snout than base of caudal; anal fin very small, its origin midway between origin of ventrals and base of caudal; caudal small, deeply emarginate; pectorals rather short, about  $2\frac{1}{2}$  in space to ventrals; ventrals small, their origin behind tip of depressed dorsal, 2 in space to origin of anal.

Color dusky blue above, often with rows of darker blotches, the lower parts silvery white; tips of snout and mandible dusky; fins yellowish to pale or whitish; basal portions of pectoral and caudal more or less dusky.

This species is common throughout southern Japan in sandy bays. Many specimens were taken at Nagasaki, Wakanoura, Misaki, Aomora, and Tokyo.

(*μικρός*, small; *ποῦς*, foot.)



8. *STOLEPHORUS* Lacépède.

*Stolephorus* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 381 (*japonicus*) (not *Stolephorus* Bleeker=*Anchovia*).

*Clupeoides* BLEEKER, Verh. Bat. Gen., XXIV, p. 17 (*macassarimensis*=*delicatula*).

*Spratelloides* BLEEKER, Verh. Bat. Gen., XXIV, p. 29 (*argyrotaenia*=*japonica*).

Body oblong, little compressed, with rather large, thin, deciduous scales. Belly rounded, without serrature. Snout conical, compressed, formed much as in *Clupea*. Teeth none or very minute and deciduous. Anal fin short, free from caudal, its rays 9 to 15. Gill membranes separate. Dorsal inserted opposite ventrals. About 6 flat branchiostegals.

Small fishes of the Indian seas, marked with a broad silvery lateral band, as in the species of *Engraulis* and *Anchovia*, a fact which led to the erroneous identification of the name *Stolephorus* with species of the latter genus. The name, however, should not be used for any anchovy.

(στολή, a stole, a white band worn by priests; φόρος, bearing; in allusion to the silvery lateral band.)

9. *STOLEPHORUS JAPONICUS* (Houttuyn.)

## KIBUNA IWASHI.

*Atherina japonica* HOUTTUYN, Verh. Holl. Maatsch. wet Haarl., XX, 1782, Pt. 2, p. 340 (Nagasaki).

*Stolephorus japonicus* LACÉPÈDE, Hist. Nat. Poiss., V., 1803, p. 381, after Houttuyn.—JORDAN and SEALE, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 770 (Negros I., Philippines).

*Clupea gracilis* SCHLEGEL, Fauna Japon. Poiss., 1846, p. 238, pl. cviii, fig. 2 (Nagasaki).

*Spratelloides gracilis* GÜNTHER, Cat., VII, 1868, p. 465 (Japan).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Hizen).

(?) *Spratelloides argyrotaenia* BLEEKER, Verh. Bat. Gen., XXIV, p. 29 (Celebes).

*Habitat*.—Southern Japan, north to Izu and Osaka, very common in sandy bays. Also in the East Indies, if *Stolephorus argyrotaenia* is the same species.

Head about  $4\frac{1}{2}$  in length; depth about 7; D. 11; A. 13; P. 14; V. 8; eye, 3 in head; snout 4; mandible 2 to  $2\frac{1}{2}$ ; interorbital space  $4\frac{1}{2}$  to 5; ventral  $2\frac{1}{4}$ ; caudal peduncle flattish,  $3\frac{1}{4}$ .

Body elongate, slender, subcylindrical; caudal peduncle and head compressed, the snout pointed; back broad, its transverse diameter about 2 in head; snout pointed; top of head flattened; eye large, with adipose lid; mouth terminal, rather small, the lower jaw very slightly projecting; maxillary comparatively broad, covering all but tip of mandible, and extending posteriorly to anterior margin of eyeball.

Teeth absent.

Gill opening large, the membranes free; gill rakers very fine and slender; gill filaments about two-thirds as long as gill rakers; pseudo-branchiæ numerous. Peritoneum dusky.

Scales large, cycloid, deciduous; no lateral line; no ventral scutes or serrated scales.

Dorsal small, its origin slightly nearer tip of snout than base of caudal; anal low, very small, very far back; distance from its origin to that of caudal about one-fifth of length without caudal fin; caudal small, deeply emarginate; ventrals small, their origin beneath middle of dorsal; pectorals inserted at lower posterior angle of opercle.

Color, uniform pale brown bluish in life, with a broad lateral silvery band, this bordered with a narrow dusky band above; a narrow median dorsal dusky band from tip of snout to base of caudal. Fins colorless, except dorsal and caudal; these marked by fine transverse dusky lines.

This beautiful little fish is common throughout southern Japan in estuaries and sandy bays. We have many from Wakanoura, Nagasaki, Heda in Izu (Capt. Alan Owston), and from the mouth of the Yodo River, at Osaka. Specimens of *Stolephorus argyrotænia* from Negros Island in the Philippines seem to differ only in having no dark streak along the upper edge of the lateral stripe, this streak being conspicuous in all adult Japanese examples.

(*japonicus*, Japanese.)

#### 9. CLUPEA (Artedi) Linnæus.

*Clupea* (ARTEDI) LINNÆUS, Syst. Nat., 10th ed., 1758, p. 317 (*harengus*).

*Rogenia* CUVIER and VALENCIENNES, Hist., Nat. Poiss., XX, 1847, p. 340 (*alba*, "the whitebait," the young of *harengus*).

True herrings with the body elongate, numerous vertebræ, the ventral serratures weak, and an ovate patch of small but persistent teeth on the vomer. The few species belong to the northern seas, where the number of individuals is inordinately great, exceeding perhaps those of any other genus of fishes. Not anadromous, spawning in the sea. (*clupea*, herring).

#### KEY TO SPECIES.

- a. Belly serrate behind ventrals only; anal rays about 14..... *pallasii*, 10

#### 10. CLUPEA PALLASII Cuvier and Valenciennes.

#### NISHIN (HERRING).

*Clupea harengus* var. PALLAS, Zoogr. Rosso.-Asiat., III, 1811, p. 209 (Kamchatka).

*Clupea pallasii* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 253 (Kamchatka; based on Pallas's specimens).

*Clupea mirabilis* GIRARD, Proc. Ac. Nat. Sci., Phila., 1854, p. 148 (San Francisco).—GÜNTHER, Cat., VII, 1868, p. 418.—JORDAN and GILBERT, Synopsis, 1883, p. 265.

*Spratelloides bryoporus* COPE, Proc. Amer. Philos. Soc., 1873, p. 25 (Sitka).—JORDAN and GILBERT, Synopsis, 1883, p. 264.

*Clupea harengus* NAMIYE, Class. Cat., 1881, p. 108 (Hokkaido).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Nemuro, Hitachi, Sakhalin). (Not of Linnæus).

*Habitat*.—North Pacific, south to northern Japan and to southern California.

Head,  $4\frac{1}{2}$  in length; depth, 4; D. 16; A. 14; scales, 52; eye, 2.5 to 3 in length of head; snout, 4; mandible,  $1\frac{3}{4}$ ; interorbital space,  $5\frac{3}{4}$ ; maxillary, 2; caudal peduncle compressed, its least depth a little less than 3 in head.

Body elongate, posterior and anterior regions compressed; head much compressed in front of eyes; sides of snout bulging; eyes large, with large adipose eyelid; mouth terminal, oblique, rather small, the lower jaw strongly projecting.

Lower jaw armed with a few small teeth, none on premaxillary; tongue and vomer each with a small patch of minute teeth arranged in a double row. Mandible largely concealed by the large maxillary,

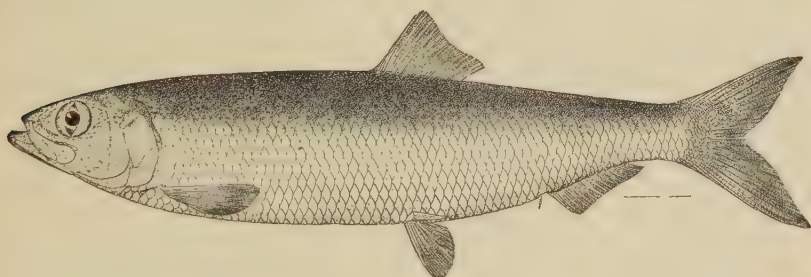


FIG. 4.—*CLUPEA PALLASII*.

which extends backward to middle of orbit or beyond. Top of head flattened, with a concavity behind interorbital region.

Gill openings quite large, the membranes free from isthmus; gill rakers very long, slender, numerous; pseudobranchiæ present; peritoneum dusky.

Scales deciduous, medium size, cycloid; scutes small, poorly developed, only between ventrals and anal.

Insertion dorsal almost midway between tip of snout and base of caudal, the fin small, its base a little less than half the length of head; anal low, its length equal to that of dorsal; caudal small, emarginate; pectorals small,  $1\frac{1}{2}$  in head; ventrals short, 2 in space to anal opening, their origin a little forward of middle of dorsal.

Color of alcoholic specimens: dusky above, sides and belly brassy or silvery; scales with a greenish opalescent luster. Fins brownish yellowish to pale.

This species, the common herring of the Pacific, is abundant in northern Japan, as throughout Alaska, and southward to southern California. About Sakhalin and Hokkaido the fisheries of Nishin or

herring have great economic importance. We have specimens from Aomori, Otaru, Matsushima, Kushiro, Same, Petropaulski (*Albatross*), and Hakodate.

#### 10. SARDINELLA Cuvier and Valenciennes.

*Sardinella* CUVIER and VALENCIENNES, Poiss., XX, 1847, p. 261 (*aurita*).

*Amblygaster* BLEEKER, Jour. Ind. Arch., III, 1849, p. 72 (*clupeioides*).

*Sardinia* POEY, Memorias, II, 1860, p. 311 (*pseudohispanica*).

This genus is close to *Clupea*, which it resembles in the elongate form and weak ventral serratures, differing in the form of the body and in the feeble skeleton. Vomer toothless, the teeth in the jaws mostly weak. Scales thin, deciduous. Adipose eyelid present. Gill rakers very numerous. Species chiefly confined to the two temperate zones, all closely related to the European Sardine, *Sardinella pilchardus*, and agreeing with it in the rich and delicate flesh; less firm than that of related species and much richer in oil. Species marine, not anadromous, known in Japan as Iwashi or Sardine. As *Sardinella aurita*, the type of *Sardinella* seems to be a true sardine, *Sardinella* must take the place of *Sardinia*. *Clupanodon*, a name sometimes used for this group, is strictly a synonym of *Opisthonema*, and has priority over the latter name for the American genus.

(*sardinia*, a sardine.)

#### 11. SARDINELLA MELANOSTICTA (Schlegel).

##### IWASHI (SARDINE).

*Clupea melanosticta* SCHLEGEL, Fauna Japon. Poiss., 1846, p. 237, pl. cvii, fig. 3 (Nagasaki).—GÜNTHER, Cat. Fish., VII, p. 430 (China, Japan).—NAMIYE, Class. Cat., 1881, p. 108 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo, Nagasaki).

*Clupanodon melanostictus* JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1901, p. 349 (Tokyo).

(?) *Clupea cæruleovittata* RICHARDSON, Ichth. Chin., 1846, p. 305 (Canton).

*Habitat*.—Shores of southern Japan and China. The Chinese species *Sardinella cæruleovittata* is apparently the same, but Schlegel's name of the same date has page precedence.

Head,  $4\frac{1}{3}$  to  $4\frac{1}{2}$  in length to base of caudal; depth, 6 to 7; D., 16 to 17; A., 17; P., 17; V., 8; scales in lateral line about 45; eye, including adipose eyelid, 3 in head; snout,  $4\frac{1}{2}$ ; mandible,  $1\frac{1}{4}$ ; interorbital space, 5; maxillary,  $2\frac{1}{2}$ ; P.,  $1\frac{1}{3}$  to  $1\frac{1}{2}$  in head, 8 in total length; V.,  $2\frac{3}{4}$  in head; caudal peduncle rounded, its least depth  $3\frac{3}{4}$  in head.

Body elongate, subcylindrical; head elongate, compressed, pointed, slightly flattened above; snout rather short and blunt. Eye large, covered by the thick adipose eyelid; mouth small, terminal somewhat oblique, the lower jaw projecting. Teeth wanting, except on tongue, which is covered with bands of excessively minute teeth, and a median row of larger, but still very small teeth. Maxillary extending poste-



riorly to a perpendicular drawn from middle of orbit. Gill openings large, membranes free from isthmus; gill rakers numerous, slender, close set, twice as long as gill filaments; pseudobranchiæ shorter than gill filaments; peritoneum dark or black.

Scales very thin, deciduous, ctenoid; or median abdominal line a series of scutes from isthmus to anus, each prolonged backward into a sharp point.

Origin of dorsal nearer tip of snout than base of caudal, its base about 7 in body without tail; distance from snout to origin of dorsal equals that from posterior end of its base to base of caudal; anal longer than dorsal, its origin midway between that of ventrals and base of caudal; caudal deeply emarginate; pectorals abdominal, about  $1\frac{2}{3}$  in head; ventrals small, their origin under middle of dorsal.

Color lustrous; bluish above, sides and belly silvery white; a row of bluish-black spots or blotches more or less evident along sides; fins pale or yellowish.

This species is the common sardine of Japan, entirely similar in habits and economic value to its homologues in America and Europe. We have specimens from Hakodate, Tokyo, Yokohama, Tsuruga, Aomori, Misaki, Same, Tateyama, Matsushima Bay, Wakanoura, Kobe, Onomichi, Hakata, and Nagasaki.

(μέλας, black; στικτός, spotted).

#### 11. HARENGULA Cuvier and Valenciennes.

*Harengula* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 280 (*latula*).

*Clupeonia* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 345 (*jussieu*).

*Kowala* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 362 (*thoracata* = *kowal*).

*Lile* JORDAN and EVERMANN, Fish. North and Mid. Amer., I, 1898, p. 431 (*stolifera*).

Small herrings of the tropical seas, with the vertebræ in reduced number, about 40 to 44, and with the scales large, usually firm and adherent, often crossed by vertical striæ; ventral scutes strong, 25 to 35 in number. Skeleton relatively firm. Adipose eyelid obsolete; lower jaw projecting; upper jaw somewhat emarginate; teeth weak. Ventrals inserted behind front of dorsal. Body compressed; cheeks not deep; gill rakers long and numerous. The genus *Harengula*, as here understood, covers considerable diversity of forms.

(Diminutive of *harengus*, a herring.)

#### KEY TO SPECIES.

- a.* Eye  $2\frac{1}{2}$  in head; scales 40 to 44; depth about 4 in length..... *zunasi*, 12  
*aa.* Eye  $3\frac{1}{2}$  in head; scales 40; depth  $3\frac{1}{4}$ ..... *moluccensis*, 13

## 12. HARENGULA ZUNASI Bleeker.

## ZUNASHI: SAPPAL.

*Clupea kowal* SCHLEGEL, Fauna Japon. Poiss., 1846, p. 235, pl. cvii, fig. 1 (Omura, Nagasaki) (not of Rüppell).

*Harengula zunasi* BLEEKER, Verh. Bat. Gen., XXVI, Japan, 1854, p. 117 (Nagasaki).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo, Bingo, Chikugo).—JORDAN and STARKS, Proc. U. S. Nat. Mus., XVIII, 1905, p. 193 (Gensan, Korea).

*Clupea zunasi* GÜNTHER, Cat. Fish., VII, 1868, p. 451 (Nagasaki).—NAMIYE, Class. Cat., 1881, p. 108 (Tokyo).

*Sardenella zunasi* JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 349 (Tokyo).

*Habitat*.—Sandy shores of southern Japan, north to Hokkaido.

Head nearly 5 in length; depth a little less than 4 in length; D. 17; A. 19; P. 15; V. 8; scales 40 to 44; eye  $2\frac{1}{2}$  in head; snout 4; inter-orbital space  $3\frac{1}{2}$ ; mandible, a trifle more than 2; pectoral  $1\frac{1}{4}$ ; V. equal to mandible; caudal peduncle compressed  $2\frac{1}{2}$ .

Body deep, much compressed, the belly sharp; dorsal and ventral profiles both convex, the latter strongly so. Head rather small, compressed, flattened above; snout short, blunt; eye rather large; mouth terminal, almost vertical, the lower jaw projecting; mandible nearly covered by the broad maxillary which extends backward almost as far as center of orbit. Tongue with a median line of very small teeth; lower jaw with a single row of minute teeth which are also sparingly present on posterior part of palatines.

Gill openings large, membranes free from isthmus; gill rakers numerous, fine, slender, longer than gill filaments; pseudobranchiæ present, rather short.

Scales thin, close-set, rather large, more or less deciduous, the margin entire; abdominal scutes present, each prolonged backward into a sharp spine; head naked, preopercle with radiating branching mucous canals beneath eye.

Origin of dorsal to tip of snout a little more than one-third of total length; distance from tip of snout to origin of dorsal equal to distance from posterior end of dorsal base to origin of caudal; anal fin small, its origin distant from base of caudal by a space equal to length of head; caudal deeply emarginate, rather long; pectorals small, about twice eye; ventrals quite small, inserted below middle of dorsal, their length contained  $1\frac{2}{3}$  times in that of pectoral.

Color, dark lustrous greenish above, sides brassy or silvery, often with an opalescent lustre. Fins yellowish to pale; no dark blotches.

This species is common in the shallow bays of southern Japan, and is often seen in the markets; we have specimens from Tokyo, Onomichi, Tomakomai, in Hokkaido, Wakanoura, Nagasaki, and Tsuruga.

The species strongly resembles *Harengula humeralis* and other scaled sardines of America.

(*zunashi*, the Japanese name.)

## 13. HARENGULA MOLUCCENSIS Bleeker.

*Harengula moluccensis* BLEEKER, Nat. Tydschr. Ned., IV, 1853, p. 609 (Molucca).—JORDAN and SEALE, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 770 (Negros).

*Clupea moluccensis* GÜNTHER, Cat. Fish., VII, p. 427 (Molucca, Ceylon, Ternate).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Miyako, Riu Kiu Islands).

*Harengula kunzei* BLEEKER, Nat. Tydschr. Ned., XII, p. 209 (Ternate).

*Habitat*.—East Indies, north to the Riu Kiu Islands.

Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. 17 or 18; scales 40–12; head longer than deep; eye  $3\frac{1}{2}$  in head. Scales crenulate, deciduous, regularly arranged; cheeks and opercles with fine radiating striæ. Gill rakers 38, fine, closely set. Ventrals inserted below middle of dorsal; 13 scutes behind ventrals. Color, plain, silvery. (Günther).

East Indies, generally common, once recorded from the Riu Kiu Islands. We have specimens from Manila, but none from Japan. (*moluccensis*, living in Mollucca.)

## 12. ILISHA Gray.

*Platyaster* SWAINSON, Classif. Anim., II, 1839, p. 294 (*africanus*); name preoccupied.

*Ilisha* (GRAY) RICHARDSON, Ichthyol. China, in Proc. Brit. Assoc., 1846, p. 306 (*abnormis*); no description.

*Pellona* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 300 (*orbignyana* = *flavipinnis*).

*Ilisha* BLEEKER, Ned. Tydschr. Dierk., 1866, p. 300 (*abnormis*).

Body much compressed, the thorax and abdomen strongly serrated. Scales moderate. Lower jaw prominent; mouth moderate, with rasp-like bands of minute teeth on jaws, palatines, pterygoids, and tongue; none on vomer. Anal fin very long; ventrals present, small, inserted before the small dorsal; upper ray of pectoral strong; caudal deeply forked. Tropical coasts of America and Asia.

(*ilisha*, apparently a corruption of Iwashi, the Japanese name for sardine.)

## 14. ILISHA ELONGATA (Bennett).

HIRAKONOSHIRO (BROAD SHAD); HIRA.

*Alosa elongata* BENNETT, Life of Raffles, 1830, p. 691 (Sumatra).

*Pellona elongata* GÜNTHER, Cat. Fish., VII, 1868, p. 456 (East Indian and China seas to Japan).—DAY, Fishes of India, 1878, p. 643, pl. CLXIV, fig. 3, and pl. CLXV, fig. 1 (India).

*Ilisha elongata* BLEEKER, Atlas Ichth., VI, 1892, p. 119, pl. CCLIX, fig. 3 (East Indies).—JORDAN and SEALE, Proc. Davenport Ac. Sci., X, p. 3 (Hongkong).

—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 328 (Formosa).

*Clupea affinis* GRAY and HARDWICKE, Ill. Ind. Zool., I, 1830, pl. xcvi (India).

*Pellona affinis* CANTOR, Catal. Malay Fish, 1850, p. 291 (Malaysia).

*Clupea melastoma* SCHLEGEL, Fauna Japonica, Pisces, 1846, p. 237, pl. cviii, fig. 1 (Nagasaki) (Not of Schneider).

*Ilisha abnormis* RICHARDSON, Ichthy. China, 1846, p. 306 (Canton).

*Pellona grayana* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 315 (India), after Gray.

*Pellona vimbella* CUVIER and VALENCIENNES, Hist. Poiss., XX, 1847, p. 317 (Macao).

*Pellona schlegeli* BLEEKER, Verh. Bat. Gen., XXVI, 1854, Japan, p. 118 (Nagasaki).

*Habitat*.—Indian Seas, north to Nagasaki and Wakanoura, scarce in Japan.

Head 4 in length; depth  $3\frac{3}{4}$ ; D. 16; A. 51; scales in lateral line about 56; diameter of eye  $3\frac{3}{4}$  in head, equal to snout, and a little more than twice the interorbital space; mandible 2 in head; least depth of caudal peduncle  $2\frac{1}{4}$  in head.

Body compressed, elongate but rather deep; abdomen and throat sharp, edged with pointed scutes; abdominal profile more convex than back; head low, compressed in front of eyes, tip of snout blunt, with bulging sides; eye rather large, the cavity about it very large, partially covered with adipose lid; mouth oblique, the upper jaw truncate, with perpendicular sides, the lower jaw very strongly projecting. Upper and lower jaws beset with stout, strongly recurved but very small teeth; bands of minute teeth on tongue, palatines, and pterygoids; none on vomer. Maxillary large, broad, reaching nearly to middle of orbit.

Top of head flattened, with two ridges forming an elongated V; muciferous branching tubules behind eye. Gill openings large, membranes free from isthmus; gill-rakers of first arch strong, rigid, longer than the gill filaments; gill-rakers of other arches much shorter; pseudobranchiæ present.

Scales more or less deciduous, large, cycloid, those on mid line of belly forming strongly serrate scutes; basal portion of caudal scaled; all other fins with basal scaly sheath. An elongated, pointed, fleshy scale in axil of pectoral.

Dorsal small, weak, its insertion midway between tip of snout and base of caudal. Anal low, very long, about  $3\frac{1}{2}$  in total length; caudal moderate, deeply forked; pectoral medium  $1\frac{2}{3}$  in head; ventrals very small, their length about  $\frac{3}{4}$  of diameter of eye.

Color pale yellowish silvery, the dorsal region dusky.

This species here described from a large specimen from Hongkong, China, collected by Capt. William Finch. It is a large herring-like fish abundant in the East Indian and Chinese seas, and occasionally taken on the coasts of southern Japan. We obtained one specimen in Nagasaki, from a Chinaman, who said that it came from the coast of China. Another was seen by us at Wakanoura.

(*elongatus*, elongate.)



## Family VII. ENGRAULIDÆ.

Body elongate, more or less compressed, covered with thin cycloid scales. Head compressed. Mouth extremely large, more or less oblique, usually overlapped by a pointed, compressed, pig-like snout. Gape very wide, the maxillary very long and slender, formed of about three pieces, extending backward far behind the eye; in some species beyond the head. Premaxillaries not protractile, very small, firmly joined to the maxillaries. Teeth usually small, in a single row in each jaw; canines sometimes present. Eye large, well forward. Pre-orbital narrow. Opercles thin and membraneous. Gill-rakers long and slender. Branchiostegals slender, 7 to 14 in number. Gill membranes separate or joined, free from isthmus. Pseudobranchiæ present. No lateral line. Belly rounded or weakly serrate. Fins various; the dorsal usually short and median; no adipose fin; caudal forked. Small, carnivorous fishes, usually swimming in large schools on sandy shores; abundant in all warm seas, occasionally entering rivers.

## KEY TO GENERA.

- a. Body moderately elongate, the anal fin not confluent with the caudal; no filaments on the pectoral fin; insertion of dorsal in advance of that of anal.
  - b. Teeth equally small; gill membranes separate.
    - c. Vertebrae about 41; bones firm; tropical species ..... *Anchovia*, 13
    - cc. Vertebrae about 45; bones feeble; species of the temperate zone. *Engraulis*, 14
  - aa. Body greatly elongate, the tail much produced; anal fin very long, confluent with the caudal ..... *Coilia*, 15

## 13. ANCHOVIA Jordan and Evermann.

*Stolephorus* BLEEKER, Ned. Tyds. Dierk., III, p. 303 ("japonicus," not of Houttuyn).

*Anchovia* JORDAN and EVERMANN, Fish. North and Mid. Amer., I, 1898, p. 449 (*macrolepidota*).

This genus, as now understood by us, includes the great multitude of tropical anchovies, characterized by the firm skeleton and by the presence of 40 or 41 vertebrae. Most of the species are compressed, translucent, and with long anal fin, and a silvery band along the sides, which has caused them to be confounded with the true *Stolephorus*. Besides the following species, assigned to Japan by Bleeker, another species, *Anchovia chinensis* Günther, has been wrongly assigned to Japan, on the supposition that it was the original of Houttuyn's *Atherina japonica*. It is recorded by Günther<sup>a</sup> as *Engraulis japonica*.

(*anchovia*, anchovy, an old name of *Engraulis encrasicolus* of Europe.)

<sup>a</sup> Cat. Fish., VII, p. 390.

## 15. ANCHOVIA INDICA (Van Hasselt).

*Engraulis indicus* VAN HASSELT, Allgem. Konst. Letterbuch, 1823, p. 329 (East Indies).—BLEEKER, Poiss. du Japon., 1879, p. 238.

*Stolephorus indicus* BLEEKER, Atlas Clup., p. 127, pl. cclix (Java, Sumatra, Celebes, Japan).

*Anchovia indica* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 328 (Suwata, Formosa).

*Engraulis albus* SWAINSON, Nat. Hist. Fishes, II, p. 293.

*Engraulis balinensis* BLEEKER, Verh. Bat. Gen., XXII, 1839, Bali, p. 11 (Bali).

*Engraulis russellii* BLEEKER, Verh. Bat. Gen., XXIV, Haring, p. 11 (East Indies).—GÜNTHER Cat. Fish., VII, p. 390 (Amboyna, Malayan Peninsula).

*Habitat*.—East Indies.

Head  $4\frac{1}{2}$ ; depth  $5\frac{3}{5}$ ; D. 16; A. 20; P. 13; scales 40.

Snout pointed, much projecting; maxillary saber-shaped, finely toothed, extending to the mandibular joint; anal inserted below middle of dorsal; abdomen with 4 long slender spines; scales thin, deciduous; a well-defined silvery lateral stripe. (Günther.)

Very abundant in the East Indies; known to us from two specimens from Formosa. Bleeker says that it extends its range northward to Japan, but there is no other record north of Formosa.

(*indicus*, Indian.)

## 14. ENGRAULIS Cuvier.

*Engraulis* CUVIER, Règne Animal, 1st. ed., 1817, p. 174 (*encrasicholus*).

*Encrasicholus* FLEMING, British Animals, 1828, p. 183 (*encrasicholus*).

This genus includes spindle-shaped anchovies, little compressed, the sides rounded, the vertebrae about 45 (44 to 47 in species examined), the flesh rather dark, tender, and somewhat oily, not translucent, the bones soft, the appearance and flesh resembling that of the sardines. Temperate zones.

(*εγγραυλῖς*, *engraulis*, the ancient name of *Engraulis encrasicholus*, the common anchovy of Europe).

## 16. ENGRAULIS JAPONICUS Schlegel.

SHIKO, IZASA.

*Engraulis japonicus* SCHLEGEL, Fauna Japon. Poiss., 1846, p. 239, pl. cviii, fig. 3 (Nagasaki).—BLEEKER, Verh. Bat. Gen., XXVI, Japan, 1854, p. 119.

NAMIYE, Class. Cat., 1881, p. 109 (Tokyo) and of Japanese writers [Reports of Imperial Fisheries Bureau, etc.] generally.—JORDAN and STARKS, Proc. U. S. Nat. Mus., 1905, p. 194 (Gensan, Korea).

*Engraulis ringens* ISHIKAWA, Prel. Cat., 1897, p. 9 (Echigo, Hizen; not of Jenyns).

*Habitat*.—Coasts of Japan and Korea, in sandy bays.

Head 4 in length, without caudal;  $4\frac{3}{5}$  in total length; depth about 7; D. 14; A. 18; P. 17; V. 7; scales in lateral series about 42; eye  $3\frac{3}{4}$  to 4 in head; snout 5; mandible  $1\frac{1}{2}$ ; interorbital space about 5; caudal

peduncle moderately compressed, its least depth from  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head.

Body elongate, subcylindrical, somewhat cigar-shaped, thickest in front of middle, head and posterior third of body laterally flattened; snout triangular, the top of head flat, with a small median ridge; lower lower side of head keel-like or wedge-shaped; eyes placed far forward, large, with large adipose lid; mouth inferior, large, the lower jaw comparatively weak, the snout projecting considerably beyond mandible. Mandible armed with a row of minute teeth. Upper jaw with similar teeth in front, these becoming larger behind and extending to posterior end of maxillary. A toothed ridge on middle line of tongue. Gillrakers of first arch slender, numerous, their length equal to that of eye; gill filaments very numerous, fine and slender, their length hardly that of gillrakers of first arch; pseudobranchiæ large, the central ones as long as gill filaments. Scales large, thin, cycloid, deciduous; no abdominal scutes; a long pointed scale in axils of pectorals and ventrals. Dorsal low, but higher than long, the second and third rays longest, their length a little less than 2 in head; the other rays rapidly decreasing, the last contained 3 or 4 times in second; origin of fin midway between tip of snout and base of caudal; anal low, its origin behind posterior end of dorsal about  $\frac{1}{2}$  diameter of eye; its length  $1\frac{3}{8}$  in head; caudal medium, deeply forked; pectorals inserted low, their length 2 in head; ventrals small, inserted less than  $\frac{1}{2}$  diameter of eye in front of a perpendicular from origin of dorsal. Color dusky blue above; sides pale brown; in some specimens a broad faint silver band from eye to base of caudal; fins pale, uniform, except caudal, which is more or less dusky. This anchovy is common throughout Japan, constituting an important article of food. We have specimens from Otaru, Hakodate, Same, Aomori, Onomichi, Wakanoura, Misaki, Tokyo, Tsuruga, and Nagasaki.

#### 15. COILIA Gray.

*Mystus* LACÉPÈDE, Poiss., V, 1803, p. 406 (*mystus*; not of Gronow, 1763).

*Coilia* GRAY, Zool. Misc., 1831, p. 9 (*hamiltoni*).

*Trichosoma* SWAINSON, Nat. Hist. Fishes, II, 1839, p. 292 (*hamiltoni*).

*Chatomus* McCLELLAND, Calc. Journ. Nat. Hist., IV, 1843, p. 405 (*playfairi*).

*Leptonurus* BLEEKER, Verh. Bat. Gen., XXII, Madura, about 1849, p. 14 (*chrysostigma*).

Body compressed, terminating in a long tapering tail; head and mouth as in *Engraulis*; scales of moderate size. Anal fin exceedingly long, confluent with caudal; the upper pectoral rays much prolonged, filamentous; belly keeled, with toothed scutes; premaxillary reaching to end of opercle or even to base of pectoral. Air bladder thick-walled, with two thin horns extending forward into the skull. East Indian region.

(Name probably without meaning.)

17. *COILIA NASUS* Schlegel.

## ETSU.

*Coilia nasus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 243, pl. cix, fig. 4 (Nagasaki).—GÜNTHER, Cat. Fish., VII, 1868, p. 405 (China and Japan).—

ABBOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 490 (Tientsin).

*Coilia grayi* KNER, Novara Fische, 1867, p. 335 (Hongkong; not of Richardson).

*Habitat.*—Coasts of China and southern Japan.

Head about 7 in length; greatest depth at beginning of dorsal, nearly 7; D. 13; A. 81; P. 6 + 10; scales 62; 11 scales before dorsal; eye  $5\frac{1}{2}$  to 6 in head; snout a little more than eye; eye and snout together  $1\frac{1}{3}$  in head; body elongate, tapering and slender posteriorly; abdomen and throat with 42 conspicuous, sharp, toothed scutes; head pointed, the snout projecting beyond the inferior mouth; premaxillary very long, becoming longer with age, tapering behind, extending to middle of base of pectoral, in young specimens frequently not reaching limit of opercle; jaws, vomer, and palatines with small, sharp-pointed teeth arranged in a single row; tongue covered with velvet-like teeth; gill-rakers fine, closely set, the longest rather longer than the eye. Dorsal rather small, its origin above that of the ventrals; distance from tip of snout to occiput nearly three times in distance to base of dorsal. Anal long and low, its height almost uniform; first six rays of pectoral greatly elongated, the filaments of various lengths, the shortest reaching at least to the beginning of the anal; caudal rather small, irregularly lanceolate or pointed, the upper rays  $2\frac{1}{2}$  times as long as the lower.

Coast of China, sometimes extending to Southern Japan; originally described from Nagasaki, but we have seen only Chinese and Korean specimens. On the coast of China is a closely related species, sometimes confounded with *Coilia nasus*. This is *Coilia ectenes* Jordan and Seale. It is more elongate, the anal rays 100 to 113. Scutes 48. Scales 72, 19 before the dorsal. Eye and snout  $1\frac{3}{4}$  in rest of head. It has not been noticed in Japan.

(*nasus*, nose.)

## Family VIII. CHIROCENTRIDÆ.

Body elongate, compressed, covered with thin, deciduous scales; abdomen with a sharp but not serrated margin; barbels none. Margin of the upper jaw formed by the premaxillaries mesially, and the maxillaries laterally; cleft of the mouth wide, oblique, the lower jaw projecting. Eye with an adipose lid. Pseudobranchiæ none. Branchiostegals 8. Lateral line obsolete. Dorsal fin short, far back, opposite the long anal. A long, pointed, appendage in axilla. Ventral fins very small. Narrow bands of teeth on palatines, tongue, and pterygoids; a row of canines in mandible and two pairs on premaxillaries.



Stomach with a blind sac; intestines short; pyloric appendages none. With two exceptions *Chirocentrus hypselosoma* Bleeker and *C. dorab*, all the species referred to this family are extinct.

#### 16. CHIROCENTRUS Cuvier.

*Chirocentrus* CUVIER, Règne Animal, 1817, p. 178 (*dorab*).

Characters of the genus included above:

(χείρ, hand; κέντρον, spine.)

#### 18. CHIROCENTRUS DORAB (Forskål).

*Clupea dorab* FORSKÅL, Descr. Anim., 1775, p. 72 (Red Sea).

*Esox chirocentrus* LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 296.

*Chirocentrus dorab* RÜPPELL, N. W. Fische, 1837, p. 81 (Red Sea).—GÜNTHER, Cat. Fish., VII, 1868, p. 475.—BLEEKER, Atlas Clup., 1870, p. 92 (East Indies).—DAY, Fishes of India, I, 1878, p. 652, pl. CLXVI, fig. 3 (India).—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., 1902, p. 327 (Formosa).

*Habitat*.—East Indies, occasionally northward to Japan.

Head about 6 in length; depth about 7; D. 17; A. 33; P. 13; v. 6; eye  $4\frac{1}{2}$  in head; snout  $3\frac{1}{2}$ ; mandible  $1\frac{1}{2}$ ; interorbital space  $5\frac{1}{2}$ ; caudal peduncle compressed,  $2\frac{1}{2}$ . Body elongate, compressed; ventral margin sharp; head small, subconical; interorbital space flat with a prominent median ridge anteriorly; snout short; eye covered with adipose lid; a conspicuous fossa before eye; mouth terminal, wide, oblique, the lower jaw strongly projecting; upper lip terminating in a short pointed cutaneous flap; maxillary not large, reaching posteriorly a little beyond anterior margin of eye; mandible longer than maxillary; lower jaw with large canine teeth; two pairs of similar teeth projecting forward from center of premaxillaries; remainder of upper jaw armed with straight, sharp teeth, which soon become much smaller posteriorly; villiform teeth in narrow bands on tongue, palatines, and pterygoid. Gill openings large, membranes free from isthmus; gill rakers short, fine; gill filaments a little longer, fine; pseudobranchiae none.

Scales small, deciduous, totally absent in our specimen; short cirri along whole extent of abdomen. Radiating, branching mucous canals beneath eye.

Dorsal small, very far back, its origin above that of anal; anal low, long, about  $5\frac{1}{2}$  in total length; caudal long, deeply forked; pectorals small, thoracic, the two fins meeting when depressed; basally covered by a long, pointed, cutaneous flap; a large, pointed, dermal, subosseous appendage in the axilla; ventrals very small, their origin midway between tip of mandible and base of caudal.

Color bluish black above, gradually paling on sides to bluish silvery; belly silvery white; fins uniform brownish.

Here described from a single specimen  $9\frac{1}{2}$  inches long, obtained by the Imperial University from the Kuro Shiwo near Misaki, the only record of the species from Japan.

This species ranges from the East Coast of Africa to the Malayan Archipelago and north to southern Japan.

(*dorab*, an Arabian name.)

#### Family IX. ALEPOCEPHALIDÆ.

Body oblong, compressed, covered with thin cycloid or keeled scales or with naked skin; head naked. Lateral line present or absent. No barbels. Mouth moderate or large; margin of the upper jaw formed by the premaxillaries and the maxillaries, the former being placed along the upper anterior edge of the latter. Teeth feeble. Opercular apparatus complete, its bones thin. Phosphorescent spots none, or rudimentary and placed in nodules of the naked skin. No adipose fin; dorsal fin long and low, posterior inserted nearly opposite the anal; pectorals short, placed rather high; ventrals usually well back, sometimes wanting. Gill openings very wide, the membranes free from the isthmus. Pseudobranchiæ present; no gular plate; no air bladder. Stomach curved, without blind sac; pyloric cœca in moderate number.

Fishes of the deep seas; numerous species have been described from the abyssal fauna of the mid Atlantic and Pacific.

#### 17. XENODERMICHTHYS Günther.

*Xenodermichthys* GÜNTHER, Ann. Mag. Nat. Hist., July, 1878, p. 23 (*nodulosus*).

Body rather elongate, compressed, without true scales; the skin rather tough, finely wrinkled longitudinally, with numerous nodules, regularly arranged; minute, rudimentary, scale-like productions are embedded in the skin, especially on the trunk. Mouth very small, with feeble jaws and rudimentary teeth in the intermaxillary and mandible and a few in the maxillary. Palate toothless. Dorsal and anal fins equal in length. Caudal forked. Gill opening wide, but not much extending above the level of the pectoral fin. Gills well developed, with long gill rakers. Deep seas.

(Ξένος, strange; δέρμα, skin; ἰχθύς, fish.)

#### 19. XENODERMICHTHYS NODULOSUS Günther.

*Xenodermichthys nodulosus* GÜNTHER, Ann. and Mag. Nat. Hist., July, 1878, p. 23 (south of Yeddo, Japan); Shore Fishes of the *Challenger*, 1880, p. 63 (off Japan).—JORDAN and STARKS, Bull. U. S. Fish Comm., 1902, p. 579 (Sagami Bay, Japan).

Head, 6 in length; depth, 7; D. 32 or 33; A. 31–33; P. 6; V. 5. Eye of moderate size, its diameter greater than width of interorbital space. Lateral line well developed, with scale-like structures; rest of body naked, with fine longitudinal wrinkles.

Color entirely black; luminous nodules all black.

Of this species we have examined one fine specimen, 21.5 cm. long, from station 3697, Sagami Bay, dredged by the United States Bureau

of Fisheries' steamer *Albatross*. It agrees fully with Günther's excellent plate.

(*nodulosus*, having nodules.)

### Family X. GONORHYNCHIDÆ.

Head and body entirely covered with ctenoid scales; a barbel present under the elongate, pointed snout; margin of upper jaw formed by the short premaxillary, which is continued downward as a thick lip, in front of the maxillary. Jaws toothless; lips thickly fringed with barbels.

Dorsal fin far back, opposite ventrals, short, like the anal.

Pseudobranchiæ present; gill openings narrow. Air bladder absent.

Branchiostegals four.

A single genus with two or three species known among living fishes. Several extinct genera are placed near *Gonorhynchus*. It differs strongly from all other herring-like fishes in having the head closely scaled.

#### 18. GONORHYNCHUS Gronow.

*Gonorhynchus* GRONOW, Zoophylaceum, 1763, (No. 199=*G. gonorhynchus*).

*Rhynchana* RICHARDSON, Voy. Erebus and Terror, 1846, p. 44 (*greyi*=*gonorhynchus*).

The characters of this genus are included above. The single Japanese species differs from *Gonorhynchus gonorhynchus* of the Cape of Good Hope and neighboring waters in the deeper body, longer head, and a smaller number of fin rays. *Gonorhynchus gonorhynchus* is said to have the head about  $5\frac{2}{3}$  in length, the dorsal 11 to 13, and the anal rays 9. *Gonorhynchus brevis* Kner, slender and short-headed, is probably the same.

#### 20. GONORHYNCHUS ABBREVIATUS Schlegel.

*Gonorhynchus abbreviatus* SCHLEGEL, Fauna Japon. Poiss., 1846, p. 217, pl. ciii, fig. 5 (Nagasaki).—JORDAN and SNYDER, Smiths. Misc. Coll., XLV, 1904, p. 236, pl. LIX (Yokohama).

*Habitat*.—Southern Japan in deep water, very rare.

Head  $4\frac{2}{5}$  in length of body to base of caudal,  $4\frac{5}{8}$  times in total length; the depth is a little more than half the length of the head, about 9 in total length; D. 11; A. 8; P. 1+10; V. 1+7; eye  $4\frac{1}{2}$  in head; snout,  $2\frac{1}{2}$ ; interorbital space, about 4; caudal peduncle,  $4\frac{1}{4}$ .

Body elongate, subcylindrical, caudal portion tapering; head medium, conical, the snout long and pointed, a single medium barbel behind its tip; nostrils double, the upper or anterior one with a short fleshy tube which partially covers the lower nostril. Mouth inferior, nearly simicircular, with thick, fringed or fibrillose, toothless jaws.

Eye large, covered with an adipose lid.

Gill membranes attached to isthmus; pseudobranchiæ present; "a fringed gill-like organ behind the fourth branchial arch, one-half being attached to this arch, the other half to the humeral arch."

Scales small, ctenoid, entirely covering the head and body, scales in lateral line, about 180.

Dorsal small, very far back, its origin opposite posterior insertion of ventrals; anal small, short, its origin a short distance behind anus, and a little more than half the distance between insertion of ventral and base of caudal; pectoral long,  $1\frac{1}{2}$  in head; a long, pointed, fleshy, scaly flap in axilla of pectorals, ventrals, dorsal and anal; caudal small, moderately forked, the basal half scaled.



FIG. 5.—*GONORHYNCHUS ABBREVIATUS*

Color uniform brown, paler beneath, fins pale basally, the distal half black; pectoral edged with white.

This description is taken from a fine specimen from off Yokohama, obtained by Mr. Alan Owston. No other specimen has been seen since the time of Schlegel.

(*abbreviatus*, shortened.)

#### SUMMARY.

##### Family ELOPIDÆ.

##### 1. *Megalops* Lacépède, 1803.

1. *cyprinoides* (Broussonet), 1782; Okinawa.

2. *Elops* Linnæus, 1766.

2. *saurus* Linnæus, 1766.

##### Family PTEROTHRISSIDÆ.

##### 3. *Pterothrissus* Hilgendorf, 1877.

3. *gissu* Hilgendorf, 1877; Hakodate, Suruga Bay, Matsushima Bay, Tsugaru Straits.

##### Family ALBULIDÆ.

4. *Albula* Gronow, 1763.

4. *vulpes* (Linnæus), 1758; Tokyo.

##### Family CHANIDÆ.

##### 5. *Chanos* Lacépède, 1803.

5. *chanos* (Forskål), 1775.



## Family DOROSOMATIDÆ.

6. *Konosirus* Jordan and Snyder, 1900.6. *punctatus* (Schlegel), 1846; Tokyo, Nagasaki.7. *nasus* (Bloch), 1797; Urado.

## Family CLUPEIDÆ.

7. *Etrumeus* Bleeker, 1853.8. *micropus* (Schlegel), 1846; Aomori, Same, Tokyo, Wakanoura, Misaki, Nagasaki.8. *Stolephorus* Lacépède, 1803.9. *japonicus* (Houttuyn), 1782; Wakanoura, Nagasaki, Osaka, Heda.9. *Clupea* Linnæus, 1758.10. *pallasii* Cuvier and Valenciennes, 1847; Otaru, Kushiro, Aomori, Matsushima Hakodate, Same.10. *Sardinella* Cuvier and Valenciennes, 1847.11. *melanosticta* (Schlegel), 1846; Hakodate, Matsushima, Aomori, Same, Yokohama, Tokyo, Tateyama, Onomichi, Wakanoura, Kobe, Tsuruga, Nagasaki.11. *Harengula* Cuvier and Valenciennes, 1847.12. *zunasi* Bleeker, 1854; Tokyo, Onomichi, Tomakomai, Wakanoura, Tsuruga, Nagasaki.13. *moluccensis* Bleeker, about 1853.12. *Ilisha* Gray, 1846.14. *elongata* (Bennett), 1830; Wakanoura.

## Family ENGRAULIDÆ.

13. *Anchovia* Jordan and Evermann, 1898.15. *indica* (Van Hasselt), 1823.14. *Engraulis* Cuvier, 1817.16. *japonicus* Schlegel, 1846; Hakodate, Aomori, Otaru, Same, Onomichi, Tokyo, Misaki, Tsuruga, Nagasaki.15. *Coilia* Gray, 1831.17. *nasus* Schlegel, 1846; Nagasaki.

## Family CHIROCENTRIDÆ.

16. *Chirocentrus* Cuvier, 1817.18. *dorab* (Forskål), 1775; Misaki.

## Family ALIPOCEPHALIDÆ.

17. *Xenodermichthys* Günther, 1878.19. *nodulosus* Günther, 1878; Sagami Bay.

## Family GONORHYNCHIDÆ.

18. *Gonorhynchus* Gronow, 1763.20. *abbreviatus* Schlegel, 1846; Yokohama.



## MAMMAL REMAINS FROM TWO PREHISTORIC VILLAGE SITES IN NEW MEXICO AND ARIZONA.

By MARCUS WARD LYON, JR.,

Assistant Curator, Division of Mammals, U. S. National Museum.

While conducting the field work of the Museum-Gates expedition of 1905, Dr. Walter Hough secured fragments of various mammals from two ancient village sites in New Mexico and Arizona. Among them are bison and marmot remains, which considerably extend the known range of these two animals.

The larger and more interesting lot was collected in a cave on the upper Tularosa River, in western Socorro County, near Joseph, New Mexico. Doctor Hough writes concerning the caves and the remains found in it, as follows:

The cavern is situated in a bluff of yellow conglomeratic tufa resembling sandstone, capping a steep slope about 250 feet above the river. Beneath the overhang and masking the cave were formerly four houses built of rubble. These had been crushed by falls from the cliff and buried under a ridge of débris which almost closed the entrance. The cave is about 30 feet deep, 11 high, and 8 wide, and was filled to within a short distance of the roof with droppings of animals containing layers of various rejects from the houses. The bison bones were found deep in this mass; one cannon bone, showing traces of fire, was taken out below the 6-foot layer.

Of the smaller and second collection, Doctor Hough says:

The animal bones of the second collection came from Blue, Graham County, eastern Arizona. They were obtained in the débris removed during the excavation of an ancient pueblo near that place.

Blue is situated in a long, deep canyon, at an altitude of about 7,000 feet.

### LIST OF MAMMAL REMAINS FROM THE CAVE ON THE UPPER TULAROSA RIVER, NEW MEXICO.

*Deer (Odocoileus sp.).*—Fragments of nearly all parts of the skeleton of one or more species of deer were found to be common. They are too small and not sufficiently characteristic to enable me to determine the species, but probably represent forms of the white-tailed deer and of the mule deer.

*Pronghorn (Antilocapra americana (Ord)).*—Skin of a young individual and fragment of the skin of an adult.

*Bison* or *American buffalo* (*Bison bison* (Linnæus)).—One upper permanent middle premolar of the right side, a portion of a rib, the distal end of a left metatarsal canon bone, the proximal end of a right metacarpal canon bone, a horn, and a small piece of skin.

In the map accompanying his memoir on the American bison (1876), Dr. J. A. Allen gives the most westerly range of this animal as just beyond the Rio Grande, while on pages 125 and 126 the bison is doubtfully recorded as extending as far west as that river. The present discovery extends its range to within a few miles of the western border of New Mexico, or about 110 miles farther west than hitherto recorded. It is even probable that the bison ranged into Arizona. As noted above by Doctor Hough, the bison remains were found deep in the débris of the cave. He remarks on this discovery as follows:

It seems clear that the buffalo existed in the neighborhood of this cave, from the number of separate bones of the skeleton occurring here, as well as from the fact that the Indians of this locality were never accustomed to carry with them masses of buffalo flesh containing bones. Their method was universally to jerk the meat, thus reducing it to small compass for carrying. The skins, however, were transported long distances and formed an article of trade between the Plains and Pueblo Indians up to the time of the disappearance of the buffalo from the plains.

*Rock spermophile* (*Citellus grammurus* (Say)).—The greater part of one skull, a portion of another, a scapula, and a few fragments of long bones.

*Marmot* or *woodchuck* (*Marmota flaviventer* or *engelhardti* ?).—The anterior portion of a skull.

I know of no marmots in collections from near this locality. The type locality of *Marmota flaviventer* is "mountains between Texas and California;" that for *M. engelhardti* is in the Beaver Range Mountains of Utah.

*Sonoran white-footed mouse* (*Peromyscus sonoriensis* (Le Conte)).—One dessicated specimen.

*Rio Grande white-footed mouse* (*Peromyscus tornillo* Mearns).—One dessicated specimen.

This and the preceding species were identified by Mr. W. H. Osgood.

*Wood rat* (*Neotoma* sp.).—A femur and the upper part of a humerus.

*Pallid muskrat* (*Fiber zibethicus pallidus* Mearns).—Two nearly complete skulls and part of another.

*Jack rabbit* (*Lepus* sp.).—A tibia and a hind foot.

*Cottontail rabbit* (*Sylvilagus* sp.).—The lower portion of a humerus.

*Plateau lynx* (*Lynx baileyi* Merriam).—A mandible, a humerus, and part of a foot.

*Scott's gray fox* (*Urocyon cinereoargenteus scottii* Mearns).—The greater portion of a skull, two mandibles, a humerus, and part of a foot.

*Common skunk* (*Mephitis estor* Merriam).—A nearly complete skull. Identified by Mr. A. H. Howell.



*Spotted skunk* (*Spilogale* sp.).—A lower jaw and the anterior portion of a skull.

*Southwestern grizzly bear* (*Ursus horribilis horriæus* Baird).—One claw.

LIST OF MAMMAL REMAINS FROM THE ANCIENT PUEBLO AT BLUE POST-OFFICE,  
EASTERN ARIZONA.

*Deer* (*Odocoileus* sp.).—Fragments of nearly all parts of the skeleton.

*Wood rat* (*Neotoma* sp.).—A femur and a humerus.

*Jack rabbit* (*Lepus* sp.).—An ulna.

*Cottontail rabbit* (*Sylvilagus* sp.).—A femur and fragment of a skull.

*Cougar or puma* (*Puma hipolestes azteca* Merriam).—Portion of a radius.

*Plateau lynx* (*Lynx baileyi* Merriam).—Part of a humerus and of a tibia.

*Scott's gray fox* (*Urocyon cinereoargenteus scottii* Mearns).—Fragments of a skull.

*Black bear* (*Ursus americanus* Pallas).—An *os calcis* and parts of ribs.



## DESCRIPTION OF A NEW ROCK-FISH OF THE GENUS SEBASTODES FROM CALIFORNIA.

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By BARTON WARREN EVERMANN and EDMUND LEE GOLDSBOROUGH,  
*Of the United States Bureau of Fisheries.*

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In connection with our recent studies of the fish fauna of Alaska and the geographic distribution of the species of fishes known to occur in the waters of that district, we examined and studied many specimens in various collections from the coasts of Washington, Oregon, and California.

Among those from the California coast we find a species of *Sebastes* which appears to us to be new. The description of the type is here given, together with a drawing by Mr. A. H. Baldwin.

**SEBASTODES ALEXANDRI** Evermann and Goldsborough, new species.

Head 2.55 in body; depth 2.8; eye 4 in head; snout 4; maxillary 2.1; mandible 1.9; interorbital 1.5 in eye, 5.75 in head; D. XIII, 9<sup>a</sup>+; A. III, 7; pores in lateral line about 52; gillrakers 8+17, rather short, 2.2 in eye, toothed, the end one a mere tubercle.

Mouth large, slightly oblique; maxillary extending to posterior edge of pupil; mandible scarcely projecting, without symphysial knob, not fitting into notch in upper jaw; armature of head strong; nasal, preocular, postocular, parietal, tympanic, and coronal spines present, the ridges all rather strong; interorbital slightly convex in the center with a slight depression just inside of each supraocular ridge; preorbital with 2 broad, blunt points; 2 humeral spines, one at upper end of opercle and one large curved one at lower end; preopercle with 5 rather strong backwardly directed spines, the second and third from the top strongest; opercles, cheek, premaxillary, and top of head closely scaled; no scales on maxillary or mandible; dorsal with a considerable notch, the twelfth spine a little greater than half length of longest, which is 2.5 in head; ventrals reaching vent; pectoral reaching tips of ventrals; small accessory scales on membranes of dorsal, anal, and

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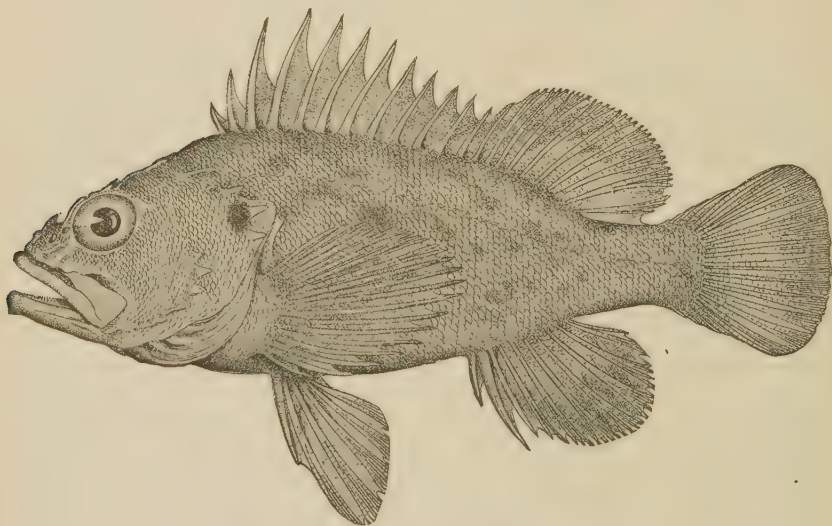
<sup>a</sup> Mutilated.

caudal fins, also on base of pectoral; second anal spine strong, curved, longer than third; inside of mouth and gill-covers pale; peritoneum silvery.

Color in alcohol, dirty yellowish; some evidence of black spots or blotches along back; a black opercular spot.

The presence of only 9 dorsal rays is doubtless due to an injury which the fish had received early in life; the upper edge of caudal peduncle and the region immediately in front apparently has been bitten or mutilated in some way.

This species appears to be related to *S. atrovirens*, from which it differs, however, in the convexity of the interorbital space, shorter



SEBASTODES ALEXANDRI.

body, the less projecting lower jaw, the smaller eye, the weaker pre-orbital spines, the longer gillrakers, and the absence of scales on the mandible and maxillary.

Described from a single specimen  $8\frac{1}{2}$  inches long (type, Cat. No. 55662 U.S.N.M.), collected by the U. S. Bureau of Fisheries steamer *Albatross* March 13, 1890, at station 3125 in 65 fathoms in Monterey Bay, California.

We take pleasure in naming this species for Mr. A. B. Alexander, assistant in charge division of statistics and methods of the fisheries, Bureau of Fisheries, in recognition of his long and valuable services as fishery expert on the steamer *Albatross*.



## MAMMALS OF BATAM ISLAND, RHIO ARCHIPELAGO.

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By MARCUS WARD LYON, Jr.,

*Assistant Curator, Division of Mammals, U. S. National Museum.*

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This paper is supplementary to one recently published by Mr. Gerrit S. Miller, jr., "on the mammals of the Rhio-Linga Archipelago. The island of Batam was twice visited by Mr. C. Boden Kloss at the instigation of Dr. W. L. Abbott, once in September, 1905, and again in March and April, 1906. The results of Mr. Kloss's first visit are embodied in Mr. Miller's paper, while the results of the second trip are here given. Batam, or Battam, about 15 miles long by 12 miles wide, is the second largest island of the Rhio Archipelago and lies about 10 miles south-southeast of Singapore Island. The channel between it and Singapore, however, contains several small islands, so that the greatest stretch of water between the two is less than 5 miles. The deepest water between it and Singapore is about 50 fathoms.

The following list contains two species not previously known from Batam, records eight other mammals not before noted on the island, while a new subspecies of one species previously known is here described.

### TRAGULUS PERFLAVUS Miller.

1906. *Tragulus perflavus* MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 251.

One specimen, the type, taken in September, 1905, and five taken in March and April, 1906. The additional specimens taken by Mr. Kloss since the type was first known confirm in every way the characters of the species. Two of them are even more yellow on the upper parts than is the type. Three other examples collected on Pulo Galang by Mr. Kloss are in every way identical with this species.

### SCIURUS VITTATUS Raffles.

1906. *Sciurus peninsularis* MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 263.

Thirteen skins and skulls collected at Senimba Bay, two in September, 1905, eleven in March, 1906. This series of skins does not differ

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<sup>a</sup> Proc. U. S. Nat. Mus., XXXI, pp. 247-286, September 11, 1906.

essentially from skins of *Sciurus peninsularis* Miller,<sup>a</sup> of the Malay Peninsula. Mr. Bonhote<sup>b</sup> has recently shown that the latter is identical with *Sciurus vittatus* Raffles.<sup>c</sup>

#### MUS CONCOLOR Blyth.

1906. *Mus concolor*, MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 267.

Four skins and skulls, collected at Senimba Bay, two in September, 1905, and two in March, 1906. It is possible that these specimens may not be typical *Mus concolor*. The only examples of true *M. concolor* in the Museum are too immature for use in making suitable comparisons. Mr. Kloss's specimens are quite close to *Mus surdus* Miller,<sup>d</sup> of Simalur Island, from which they differ mainly in smaller size of skull, shorter rostrum, and greater interorbital width.

#### MUS BATAMANUS, new species.

*Type*.—Adult male, skin and skull, Cat. No. 143232, U.S.N.M., collected at Senimba Bay, Batam Island, off southern end of Malay Peninsula, March 30, 1906, by Mr. C. Boden Kloss. Original number 75.

*Diagnostic characters*.—Similar to *Mus jerdoni* Blyth, but tail shorter than head and body, and, as compared with a Tenasserim example of *M. jerdoni*, duller colored, and with slightly heavier interorbital region.

*Color*.—Upper parts generally an ill-defined grizzle of dull ochraceous buff<sup>e</sup> and blackish, much lighter and duller on the sides, and with much less admixture of black; underparts generally similar to Ridgway's No. 9 gray. Ears blackish brown; feet whitish. Tail, bicolor, dark brownish above, whitish beneath. The soft or typical hairs above have dull ochraceous tips and No. 6 gray bases; on the lower parts their tips are whitish and bases No. 8 gray. The pelage is everywhere beset with grooved and flattened spines, longest and most numerous above, where their bases are slate gray in color and the tips slate black. On the underparts the spines are less numerous, smaller and whitish throughout. On the sides the bases of the spines grow lighter in color, becoming whitish as the belly is reached. Many of the spines on the upper sides of the body are tipped with dull ochraceous buff, and as the belly is approached all the spines are so tipped.

*Skull*.—The skull of *Mus batamanus* does not differ conspicuously from skulls of *Mus jerdoni*; the palatine foramina are shorter and

<sup>a</sup> Smithsonian Miscell. Coll., XLV, p. 10, November 6, 1903.

<sup>b</sup> Proc. Zool. Soc. London, 1906, I, pp. 5, 6, published June 7, 1906.

<sup>c</sup> For a consideration of the Sumatran forms of this species and the status of *Sciurus peninsularis*, see Lyon, Smithsonian Miscell. Coll., XLVIII, 1906, p. 278.

<sup>d</sup> Proc. U. S. Nat. Mus., XXVI, p. 460, February 3, 1903.

<sup>e</sup> Color terms in this paper are taken from Ridgway's Nomenclature of Colors for Naturalists.

wider, the posterior edge of the palate more emarginate, and the interorbital region is slightly heavier.

*Measurements of type.*—Total length, 267 mm.; head and body, 148; tail, 129; hind foot, without claws, 31; greatest length of skull, 36.3; basal length, 30.5; condylo-basal length, 34.5; zygomatic width, 15.3; interorbital constriction, 6.5; maxillary tooth row (alveoli), 6.2; mandible back of condyle to front of symphysis, 19.7; mandibular tooth row, 5.9.

*Specimens examined.*—One, the type.

#### MUS LINGENSIS Miller.

1906. *Mus lingensis* MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 266.

One skin and twelve skulls collected at Senimba Bay in September, 1905, and eight skins and skulls March and April, 1906. This series, as a whole, is exactly like a series of topotypes from Linga. This species shows much variation in the size of the skull. In the series from Batam, the greatest length of the largest skull, Cat. No. 143217, U.S.N.M., with teeth considerably worn, is 48.3 mm., while in Cat. No. 143221, U.S.N.M., a skull in every way adult, with teeth slightly worn, the same measurement is 42.5 mm. Similar differences in size are found in examples from Linga.

#### MUS sp. near RATTUS.

1906. *Mus near rattus*, MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 266.

Four specimens taken September, 1905, and twelve taken in March and April, 1906. This rat is extremely variable. The series of skins falls into two groups—those with bellies nearly white, like specimens of *Mus jarak* Bonhote, from southern Johore, and those with dirty, buffy-gray bellies, much like a specimen of *Mus griseiventer* Bonhote, from Johore. Some individuals are nearly intermediate between these extremes of coloration of the under parts. As great differences are found in the color of the upper parts, some individuals being colored like a small Norway rat, while others are nearly as dark as a black rat. As a rule, those specimens darkest above are lightest beneath, but there are exceptions. The skulls also show many inconstant variations.

#### MUS FIRMUS Miller.

Three adults, skins and skulls, collected at Senimba Bay, March, 1906, do not differ from topotypes of this species from Linga.

#### ARCTOGALIDIA SIMPLEX Miller.

1906. *Arctogalidia simplex* MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 268.

An adult female taken in September, 1905.

## TUPAIA FERRUGINEA BATAMANA, new subspecies.

1906. *Tupaia ferruginea*, MILLER, Proc. U. S. Nat. Mus., XXXI, 1906, p. 271.

*Type*.—Adult female, skin and skull, Cat. No. 142151, U. S. N. M., collected at Senimba Bay, Batam Island, south of Malay Peninsula, September 15, 1905, by Mr. C. Boden Kloss. Original number 2.

*Diagnostic characters*.—Very similar to *Tupaia ferruginea* Raffles, of Singapore and Malay Peninsula, but tail grayer, skull and teeth heavier.

*Color*.—*Tupaia ferruginea batamana* so closely resembles the typical form that no detailed description is necessary; in the majority of specimens the tail is grayer than it is in the mainland animal.

*Skull and teeth*.—The skull of *Tupaia ferruginea batamana* averages longer and wider than skulls of the typical form and the sagittal crest is longer and more prominent. The angle of the mandible is heavier. The molar teeth are heavier throughout. For the greater size of the skull of the insular subspecies over the mainland form, see table of measurements, page 657. The difference in size is very strikingly brought out by placing the two series of skulls side by side so that the zygomatic arch of one touches that of the next. When the eight skulls of each series are so arranged, it is found that the skulls of *Tupaia ferruginea batamana* make a row longer by the width of half a skull than the corresponding row of *Tupaia ferruginea*. If the two series are arranged longitudinally, the row of island skulls extends about a third of a skull beyond the row of mainland skulls.

*Measurements*.—External and cranial measurements of the type: Total length, 360 mm.; tail vertebrae, 160; hind foot without claws, 43; ear, 17; greatest length of skull, 53; basal length, 46.5; palatal length, 28.8; zygomatic breadth, 27.5; greatest width between outer surfaces of molars, 17.5; interorbital constriction, 15.4; breadth of brain case above roots of zygomatics, 20; mandible, front of symphysis to back of condyle, 35.2. For cranial measurements of the series, see table, page 657.

*Specimens examined*.—Eight, two skins and skulls collected in September, 1905, and six in alcohol, collected at the same time but not received until the later collection was sent in.

*Remarks*.—The characters of this subspecies were pointed out by Mr. Miller, who had at his disposal the two skins and skulls only. The six additional specimens later received from Mr. Kloss confirm in every way the characters that were previously shown to be present.



Measurements of skulls of *Tupaia ferruginea* and of *Tupaia ferruginea batamana*.

| Name.                               | Locality.  | Cat. Number. | Sex and age.   | Length of sagittal crest. | Greatest length of skull. | Zygo-matic width. | Front of first incisor to back of last molar. |
|-------------------------------------|------------|--------------|----------------|---------------------------|---------------------------|-------------------|-----------------------------------------------|
|                                     |            |              |                | mm.                       | mm.                       | mm.               | mm.                                           |
| <i>Tupaia ferruginea</i>            | Singapore  | 105078       | Female adult.  |                           |                           | 25.4              | 27.5                                          |
| Do.                                 | do         | 105079       | do             | 4.5                       | 48.7                      | 24.7              | 26.5                                          |
| Do.                                 | do         | 105080       | Male adult     | 5.7                       | 49.7                      | 24.8              | 27                                            |
| Do.                                 | Tringanu   | 105024       | Female adult.  | 5                         | 50.3                      | 24.3              | 27.9                                          |
| Do.                                 | do         | 105033       | do             | 5.6                       | 50.1                      | 25.4              | 27.1                                          |
| Do.                                 | Pahang     | 115491       | do             | 6                         | 51.8                      | 24.8              | 28                                            |
| Do.                                 | Johore.    | 112578       | Male adult     | 5                         | 50.7                      | 26.3              | 27.5                                          |
| Do.                                 | Tenasserim | 124284       | do             | 6.6                       | 52                        | 25.6              | 27.3                                          |
| <i>Tupaia ferruginea batamana</i> . | Batam      | 142151       | Female adult a | 7                         | 53                        | 27.5              | 29                                            |
| Do.                                 | do         | 142152       | do             | 8                         | 51.8                      | 26.2              | 27.8                                          |
| Do.                                 | do         | 143255       | do             | 6.8                       | 52.3                      | 26.9              | 28.6                                          |
| Do.                                 | do         | 143256       | do             | 7                         | 52.3                      | 26.8              | 28.6                                          |
| Do.                                 | do         | 143257       | do             | 8.2                       | 50                        | 26.2              | 27.5                                          |
| Do.                                 | do         | 143252       | Male adult     | 7.7                       | 52.6                      | 27.2              | 28.7                                          |
| Do.                                 | do         | 143253       | do             | 10                        | 52.7                      | 27.3              | 28.2                                          |
| Do.                                 | do         | 143254       | do             | 9.4                       | 53.1                      | 27                | 27.9                                          |

a Type.

In addition to the foregoing, Mr. Kloss saw the following species on Batam, but was unable to secure specimens:

*Sus oi.*<sup>a</sup>*Sus rhionis*.*Macaca fascicularis*.*Presbytis cristata*.

The following were reported to Mr. Kloss by the natives as occurring on Batam:

*Tragulus kanchil*.*Petaurista* sp.*Sciuropterus* sp.*Sciurus tenuis*.*Ratufa* sp.*Paradoxurus* sp.*Cynocephalus*<sup>b</sup> sp.*Macaca nemestrina*.*Presbytis* sp. with white breast.

<sup>a</sup> See Kloss, Journ. Straits Branch, Royal Asiatic Society, XLV, pp. 55-60, pls. I-III, made from photographs of Batam specimens obtained by Mr. J. P. Romenij.

<sup>b</sup> See Miller, Proc. Biol. Soc., Washington, XIX, p. 41, February 26, 1906.



AN ACCOUNT OF AMAZON RIVER FISHES COLLECTED BY  
J. B. STEERE; WITH A NOTE ON PIMELODUS CLARIAS.

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By CARL H. EIGENMANN,  
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and

BARTON A. BEAN,  
*Of the Division of Fishes, U. S. National Museum.*

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During 1901, Prof. J. B. Steere made collections for the United States National Museum in the Amazon River between Para and Manaos. Among these collections were a number of fishes, nearly all of medium size, which were selected of a certain length for exhibition at the Pan-American Exposition held in Buffalo, New York, in 1901. Most of them were displayed in formalin, and proved an interesting addition to the exhibit of fishes made by the Museum.

The collection contains a number of interesting forms, several of which are here described as new. We are indebted to Dr. Theodore Gill for suggesting the name *Tenionema* for the catfish with the flattened (tape-like) barbels, named specifically in honor of Professor Steere.

A note on some specimens of *Pimelodus clarias* from Paraguay is added to this paper.

POTAMOTRYGON HUMBOLDTII (Roulin).

One specimen.

SELENASPIS HERZBERGII (Bloch).

Three specimens, 185, 175, and 145 mm. long. These agree well with Bleeker's figure of *Hexanematichthys hymenorhinos*, which is evidently the young of *herzbergii*.

CALLOPHYSUS MACROPTERUS (Lichtenstein).

Two specimens.

PINIRAMPUS PIRINAMPU (Spix).

One specimen.

## LUCIOPIMELODUS AGASSIZII (Steindachner).

The species resembles in general appearance *Pimelodus altipinnis*, but differs in the generic characters, which are as follows: No vomerine teeth; occipital process narrow, not reaching to dorsal plate; a frontal and a small occipital fontanelle. Bones of the head striate. Dorsal and pectoral spines not pungent, but obliquely segmented in their distal third; the anterior margin roughened by the prolongation of each segment into a small spine. Posterior margin of dorsal spine smooth; that of the pectoral serrate. Adipose dorsal very long; caudal widely forked; barbels flat, slightly margined.

Our specimen is 150 mm. long, and agrees well with Steindachner's description. The head is contained 5 times in the length of body and not 3 times, as given by Eigenmann and Eigenmann.

This fish was considered a distinct genus by Eigenmann and Eigenmann, who, however, did not name it because they had no specimen for direct examination. The genus was later named *Perugia* by Eigenmann and Norris. The example from the Steere collection shows that it is generically identical with *Luciopimelodus* of Eigenmann and Eigenmann.

## RHAMDIA QUELEN (Quoy and Gaimard).

Three specimens.

## PIMELODELLA CRISTATUS Muller and Troschel

One specimen.

## PIMELODUS ALTIPINNIS Steindachner

One specimen.

## Genus BRACHYPLATYSTOMA.

The genus *Brachyplatystoma* is distinguished technically from other *Pimelodinae* by the character of the premaxillary teeth. These are of two kinds, those on the anterior half of the premaxillary are villiform and fixed, while those on the posterior are longer, slenderer, and depressible. Six species are known: *filamentosum*, *vaillanti*, *reticulata*, *rousseaurii*, *juruense*, and *platynema*. Some of these species reach a very large size. Of *rousseaurii* (Goliath) Kner says that he had specimens 6 feet long, and of *filamentosum* Goeldi recorded a specimen 1.95 meters long.

*B. reticulata* is known to reach a length of 3 feet.

The species change greatly with age; the young have fantastically elongated maxillary barbels and caudal filaments, so that the filament of the upper caudal lobe may be much longer than the rest of the fish, and the maxillary barbels may be twice the length of the fish, while in the adult the maxillary barbels may reach but little beyond the pectorals, and the caudal filament be correspondingly shortened.



## BRACHYPLATYSTOMA GOELDII, new species.

The species here described is distinguished from others by the large spots on the upper half of the body. The type, a single specimen, is 223 mm. long to end of middle caudal rays. Barbels flattened; the maxillary barbel of one side 485 mm. long. Upper caudal lobe with the filament (broken at the tip) 293 mm. long. Head depressed, as in the other members of the genus, twice its depth at the occipital process. Upper jaw projecting an orbital diameter beyond the lower. Eye  $4\frac{1}{2}$  in the snout,  $9\frac{1}{3}$  in the head,  $2\frac{1}{2}$  in interorbital. Width of head at rictus equal to snout and half the orbit. Occipital process scarcely reaching dorsal plate. Mental barbels reaching gill-opening, and the post mentals beyond base of pectorals. Premaxillary band of teeth wider than the vomerine band. Gill-membranes separated to the angle of the mouth. Gill-rakers slender and shorter than the eye. Skin on top and sides of head, and region along the anterior part of the lateral line, reticulated.



FIG. 1.—BRACHYPLATYSTOMA GOELDII.

Dorsal spine midway between tip of snout and middle of adipose; roughened in front and behind. Adipose equal to the anal in length. Lower caudal lobe without filament; equal to the head in length. Ventrals reaching about  $\frac{2}{3}$  to anal, and the pectorals about  $\frac{2}{3}$  to ventrals.

Color.—Dark above; white below; a number of round spots on the upper half of the body, each about equal in size to the diameter of the orbit. The base of the dorsal, caudal lobes, and anal distinctly rusty.

This species is readily distinguished from *B. vaillanti* by its short adipose fin and coloration; from *rousseaui* by its projecting upper jaw, coloration and length of barbels; from *filamentosus* by its coloration, and shape of the vomerine patches of teeth, which in this species are very much wider than those of the palatines, while they are nearly of the same width in *filamentosus*. From *platynema* and *juruense* it is distinguished by its exaggerated barbels, coloration, and projecting jaw.

We take pleasure in naming this species for Dr. Emilio A. Goeldi, of the Museo Paraense, who has described the modifications with age in the species of this genus.

*Type*.—Cat. No. 52561, U.S.N.M.

**BRACHYPLATYSTOMA VAILLANTI** (Cuvier and Valenciennes).

**BRACHYPLATYSTOMA ROUSSEAUXXII** (Castelnau).

One specimen each.

**TÆNIONEMA**, new subgenus.

This subgenus resembles *Brachyplatystoma* but has flattened band-like barbels and a minute eye. Vomerine patches of teeth much deeper than the palatine patches, the two forming a comma-shaped patch much as in *Pseudoplatystoma*. Head extremely depressed; dorsal and pectoral spines feeble, not pungent.

*Type*.—*T. steerei*, new species.

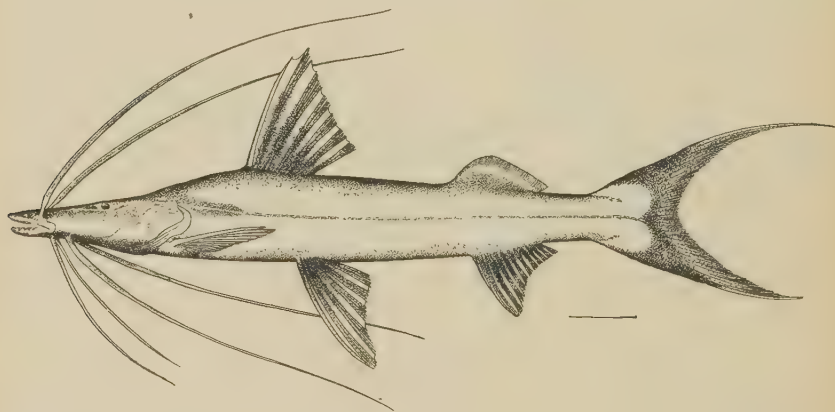


FIG. 2.—TÆNIONEMA STEEREI.

**TÆNIONEMA STEEREI**, new species.

Head extremely depressed, about three times as long as deep, its length contained  $3\frac{1}{2}$  times in length of body. Snout spatulate, projecting little beyond the mandible; eye extremely small, situated in the posterior half of the head, its diameter contained 3 times in the interorbital (4 times in *platynema*); occipital process short, widely separated from the dorsal fin; upper half of the head covered with reticulated skin; eye a little more than twice as long as the fontanelle, its diameter contained 17 times in length of head, about 10 times in snout. Maxillary barbel reaching tip of ventrals. Branchiostegals 12. D. I, 6; A. III, 12; head,  $3\frac{1}{2}$ ; depth,  $7\frac{1}{2}$ .

The first ray of the dorsal is contained  $1\frac{1}{2}$  times in length of head; adipose fin  $2\frac{1}{2}$  times as long as deep. Length of base of adipose fin

contained  $1\frac{1}{2}$  times in its distance from the dorsal. Anal emarginate; the highest branched ray is  $2\frac{1}{2}$  times as long as the last. Pectoral  $1\frac{3}{5}$  in head; ventral much longer than pectoral, equal to its distance from the base of the pectoral,  $1\frac{2}{5}$  in head. Caudal deeply forked, the lobes prolonged in filaments. Caudal peduncle  $2\frac{1}{2}$  times as long as deep.

Silvery; darker above.

Length of specimen to end of middle caudal rays, 260 mm.

This species is very nearly allied to, if not identical with, *platynema* of Boulenger, from which it differs only in the size of the fins. *Brachyplatystoma platynema* may be referred to this subgenus.

Type.—Cat. No. 52571, U.S.N.M.

#### PLATYSTOMATICHTHYS STURIO (Kner).

Three specimens.

DORAS DORSALIS Cuvier and Valenciennes.

One specimen.

#### TRACHYCRYSTES GALEATUS (Linnæus).

Three specimens.

#### PSEUDAUCHENIPTERUS NODOSUS (Bloch).

Four specimens. All females. One with mature eggs. Dark blue above, extending on the sides to a greater or less extent. The wavy lateral line white; free from pigment. Caudal margined with black; the upper lobe with a more or less distinct black streak. Dorsal spine with a large swelling at the base.

#### AGENEIOSUS UCAYALENSIS Castelnau.

*Ageneiosus militaris* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XV, 1840, p. 232.

*Ageneiosus militaris*, VALENCIENNES, Voy. d'Orbigny, IX, 1847, atlas, II, pl. iv, fig. 1.

*Ageneiosus ucayalensis* CASTELNAU, Anim. Am. Sud., XLIX, 1855, pl. xvii, fig. 2.

*Ageneiosus militaris*, KNER, Sitzb. Ak. Wien, XXVI, 1857, p. 437.

*Ageneiosus militaris*, GÜNTHER, Cat. Fish. Brit. Mus., V, 1864, p. 191.

*Ageneiosus valenciennesi* BLEEKER, Silures de Suriname, 1864, p. 82 (based on Valenciennes).

*Ageneiosus valenciennesi*, EIGENMANN and EIGENMANN, Proc. Cal. Acad., 2d Ser., I, 1888, p. 150.

*Ageneiosus ucayalensis*, EIGENMANN and EIGENMANN, Proc. Cal. Acad., 2d Ser., I, 1888, p. 150.

We have before us five specimens. Two are males measuring 196 mm. and 180 mm., and the other three are females, 200, 230, and 270 mm. long. It is very probable that these belong to the same species. The males apparently represent the *A. valenciennesi* of Bleeker, while the females represent the *A. ucayalensis* of Castelnau.

The differences between the males and females are as follows:

*Male.* *a.* Maxillary barbel erectile, spinous, with 5 or 6 accessory spines on its anterior surface; profile very strongly concave; a bulge on the anterior surface near dorsal base; dorsal more or less crooked; equal or greater in height than its distance from the tip of the snout; its anterior margin spinulous, hooks more or less regularly turned to the right or left; posterior surface of dorsal spine smooth. Pectoral spine a little longer than snout and eye, nearly smooth in front and with recurved hooks behind. Eye 3 in snout, 6 in head, 3 in interorbital. Caudal margined with black. One of the males everywhere much darker than the other. (Two specimens.)

*Female.*—*aa.* Maxillary barbel minute, its base cartilaginous, its tip not reaching to the end of the premaxillary by a distance equal to the diameter of the pupil. Dorsal spine feeble, not as long as the first ray, its length contained a little more than twice in its distance from the tip of the snout. Pectoral spine slender, smooth in front, with recurved teeth behind; about equal in length to snout and orbit. Eye  $3\frac{1}{2}$  to 4 in snout;  $6\frac{1}{2}$  in head;  $3\frac{3}{4}$  in interorbital. Caudal not margined with black. Profile but little concave. (Three specimens.)

#### HYPOPHthalmus EDENTATUS Spix.

One specimen.

#### HEMICETOPSIS CANDIRU (Spix).

One specimen, a male, agreeing with the description of Eigenmann and Eigenmann except in the character of the dorsal and pectorals. The



FIG. 3.—PARACETOPSIS OCCIDENTALIS. (After Steindachner.)

first ray of each of these is prolonged. The first dorsal ray is  $2\frac{1}{2}$  times as long as second, being prolonged with a filament. The first pectoral ray is similarly prolonged, being about twice the length of the second ray and reaching to the ventrals.



Steindachner has<sup>a</sup> called attention to this prolongation of the fin rays in the males.

The genus *Cetopsis*, as understood by Eigenmann and Eigenmann, contains four distinct generic types; one of these was described by Agassiz (*Cetopsis*); two others by Bleeker (*Hemicetopsis* and *Pseudocetopsis*); the fourth, with *occidentalis* as the type, may be named *Paracetopsis* (see fig. 3).

The genera may be diagnosed as follows:

- a. Teeth conical or incisor-like; those on the vomer in a single series. Ventrals free or united to the belly ..... *Hemicetopsis*
- aa. Teeth on premaxillary villiform, in a band; those on the vomer and on the mandible incisor-like in a single series. Ventrals partly united to the belly ..... *Cetopsis*
- aaa. Teeth on the premaxillary and mandible villiform, in bands; those of the vomer in one or more uninterrupted series, incisor-like; ventrals united with each other. .... *Pseudocetopsis*
- aaaa. Teeth all villiform, in bands, those on vomer in two patches; ventrals partly joined to the belly ..... *Paracetopsis*

#### LORICARIA CATAPHRACTA Linnæus.

Nine specimens.

#### PLECOSTOMUS PLECOSTOMUS (Linnæus).

Four specimens.

#### PSEUDACANTHICUS SPINOSUS (Castelnau).

One specimen.

#### HEMIANCISTRUS VITTATUS Steindachner.

Two specimens.

#### PTERYGOPLICHTHYS MULTIRADIATUS (Hancock).

Three specimens.

#### ANCISTRUS DOLICHOPTERUS Kner.

Two specimens.

#### HOPLOSTERNUM THORACATUM (Cuvier and Valenciennes).

One specimen.

#### STERNARCHELLA SCHOTTI (Steindachner).

One specimen  $7\frac{1}{2}$  inches long.

<sup>a</sup> Flussf. Sudam., IV, p. 5.

## STERNARCHORHYNCHUS MORMYRUS (Steindachner.)

In the general contour of the head these specimens agree with *S. curvirostris* Boulenger, but in the shape of the snout they agree more nearly with *S. mormyrus* Steindachner; in the number of anal rays (191–194) the specimens are intermediate between the two species. We are inclined to think, therefore, that *curvirostris* will prove identical with *mormyrus*.

## RHAMPHICHTHYS MARMORATUS Castelnau.

Two specimens 14 and 16 inches long, respectively.

Anal rays 225–226. Eye equidistant from gill-opening and tip of snout, or nearer the former. Depth  $1\frac{1}{5}$  to  $1\frac{1}{6}$  in the length of the head. The snout of one of the specimens is upturned.

## RHAMPHICHTHYS REINHARDTI (Kaup).

One specimen 29 inches long. Anal rays 396.

## HYPOPOMUS ARTEDI Kaup.

Two specimens. Anal rays 220 and 226.

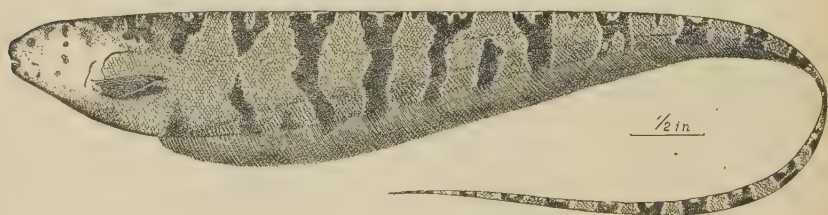


FIG. 4.—STEATOGENYS ELEGANS.

## STEATOGENYS ELEGANS (Steindachner).

One specimen, 9 inches long.

## EIGENMANNIA TROSCHELI (Kaup).

A single specimen intermediate in some respects between *axillaris* and *troscheli*, confirming the opinion of Steindachner that the two are synonymous. Anal beginning under the second fifth of the pectoral.

## GYMNOTUS CARAPO Linnaeus.

Four specimens,  $13\frac{1}{2}$ ,  $14\frac{1}{2}$ ,  $15\frac{1}{2}$ , and 17 inches long, respectively.

## OSTEOGLOSSUM BICIRRHOSUM Agassiz.

D. 44; A. 54; V. I, 5; scales 34. Two specimens, 15 and 16 inches long, respectively.

## ELOPOMORPHUS ELONGATUS (Spix).

A single specimen, 10 inches long.

## CURIMATUS KNERI Steindachner.

One specimen,  $4\frac{1}{2}$  inches long.

## PROCHILODUS TÆNIURUS Valenciennes.

Two specimens, 11 and  $11\frac{1}{2}$  inches long, respectively.

## HEMIODUS IMMACULATUS Kner.

D. 11; A. 11; scales 66. One specimen, 9 inches long.

## MACRODON TRAHIRA (Spix).

D. 14; A. 10; scales 39. One specimen,  $9\frac{1}{4}$  inches long.

## ASTYANAX BIMACULATUS (Linnæus).

Three specimens,  $3\frac{1}{4}$ ,  $3\frac{1}{4}$ , and 3 inches long, respectively.

## CHALCINUS ELONGATUS Günther.

Three specimens,  $7\frac{1}{4}$ ,  $7\frac{1}{2}$ , and 8 inches long, respectively.

## PYGOPRISTIS SERRULATUM Cuvier and Valenciennes.

One specimen, 15 inches long.

## MYLOSSOMA ALBISCOPUS (Cope).

One specimen,  $4\frac{1}{2}$  inches long, with 45 abdominal senæ. Scales in lateral line 100. The depth of the body is contained  $1\frac{2}{3}$  times in its length; the head  $4\frac{1}{5}$  times in the same length. The shape of the head resembles *aureus* more than *albiscopus*, as figured by Spix.

## RHAPHIODON VULPINUS Spix.

Four specimens.

## HOPLERYTHRINUS UNITÆNIATUS (Spix).

Two specimens,  $8\frac{1}{4}$  and  $8\frac{1}{2}$  inches long, respectively.

## ENGRAULIS ATHERINOIDES (Linnæus).

## ANABLEPS TETROPTHALMUS Bloch.

Three specimens,  $5\frac{3}{4}$ ,  $7\frac{1}{4}$ , and  $10\frac{1}{2}$  inches long, respectively.

## NOTE ON A PARAGUAYAN FISH.

## PIMELODUS CLARIAS (Bloch).

Four specimens have a number of characteristics in common. These have the humeral spine a little more convex on the dorsal margin than the ventral margin, but without distinct notches. The dorsal plate is composed of two elements, the anterior of which is separate from the posterior in the young and shows a suture in the adult. The adipose fin is contained  $4\frac{3}{4}$  times in the length of the fish. The dorsal plate is long, and measures at least twice as much along the median line as along the sides.

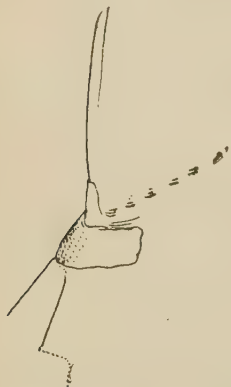


FIG. 5.—DORSAL PLATE OF  
PIMELODUS CLARIAS.

The specimens are all faded and worn. The upper dorsal membranes are dusky, the dorsal margin blackish.

The foregoing notes relate to specimens Nos. 1552, 1556, and 1646, U.S.N.M.

Specimens in the Indiana University Museum, No. 9828 from Paraguay, and No. 9276 from Iguape, showing otherwise the same characteristics as those above mentioned, have the sides and back with several series of small spots, which extend on the caudal fin.

Another specimen differs notably from any of those described above. The dorsal margin of the humeral plate is very different from the ventral; its middle third is concave, the concave part being joined to the very obliquely-descending posterior margin at a distinct angle. The dorsal plate is very little longer along the median line than it is on the sides, the suture between the two elements composing the plate being much less conspicuous than in the preceding specimens. The adipose is contained 5 times in the body length. The maxillary barbel reaches to the end of the adipose. There are patches of teeth on the pterygoids, and very minute ones on the vomer.

Specimens in Indiana University, Nos. 9826 and 10286 from Paraguay, and No. 4268 from Tabatinga, that resemble this specimen except in the length of the barbels, are bright silvery in color, without spots.



# NORTH AMERICAN PARASITIC COPEPODS BELONGING TO THE FAMILY CALIGIDÆ.

## PART 2.—THE TREBINÆ AND EURYPHORINÆ.

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### INTRODUCTION.

This fourth paper in the series based upon the collection belonging to the United States National Museum is really a continuation of the third, which was published in Vol. XXVIII of these Proceedings.

It takes up the second and third subfamilies of the Caligidæ and includes the five species belonging to these subfamilies which have thus far been found in North American waters and three which are foreign, but at the same time are represented in the Museum collection.

Of the five native species one, *Dysgamus ariommus*, is new to science; the others have been described elsewhere, but three of them, *Gloiopotes ornatus*, *Alebion gracilis*, and *Alebion glaber*, have never before been figured.

In conformity with the policy adopted for this series of papers, the artificial keys under the subfamilies and genera, which are here for the first time presented, are made to include all the known genera and species, respectively.

Since both the subfamilies here treated are new to science, their ontogeny is also new. This is especially true of the continuous life-history of the genus *Alebion*, with the figures of its metanauplius and the anatomical details of the latter, upon which is based the *raison d'être* of the subfamily Euryphorinæ.

### Subfamily TREBINÆ.

Sexes similar as in the Caliginæ. First and second thorax segments united with the head to form a broad and flattened carapace. The various regions on the dorsal surface separated by distinct grooves arranged differently from those in the other subfamilies. Third and fourth segments free and without dorsal plates or any appendages

except the thoracic legs. Genital segment enlarged, but never much more than half the size of the carapace. Abdomen elongate; anal laminae long and narrow. Furca and first maxillae both present. All the swimming legs biramose; rami of first pair two-jointed, of the other pairs three jointed, except in *exilis*, where the fourth pair has a two-jointed endopod. Egg strings as in the Caliginæ. Adults active, both sexes swimming about freely. The young reported by Krøyer (1863) and Olsson (1869) to pass through a ehalimus stage in which they are attached by a frontal filament, the remains of which can be plainly seen in the median incision of the frontal plates in later stages of development (fig. 2).

This subfamily stands as a connecting link between the Caliginæ and the Euryphorinæ. In its development it is almost identical with the Caliginæ, but in its morphology it is radically different from them and more closely resembles the Euryphorinæ, though differing from the latter also in many important particulars. At present it is composed of the single genus *Trebius*.

It would seem at first as if this genus could be included either with the Caliginæ or the Euryphorinæ, rather than separated from them both.

Krøyer, Steenstrup and Lütken, and Heller place it with the Caliginæ, while Gerstaecker puts it with his "Nogagina" (Euryphorinæ). The following considerations have seemed sufficient to the author to warrant its separation in a subfamily by itself:

A. If it were included with the Caliginæ—

1. It would be the only genus having more than a single free thorax segment. In all the other genera the three anterior segments of the thorax are fused with the head to form a carapace, which has the same general shape in every genus and the same arrangement of grooves and areas. Moreover, the fusion is complete, and despite the grooves there is very little motion, if any, between the different areas. Here in *Trebius* only two thorax segments are fused with the head, and there are several important differences in the grooves and areas.

For instance, the thoracic area, which in the Caliginæ includes the three anterior thoracic segments, is here restricted to the second segment alone and has been so much shortened as to become transversely semilunar. Again, the grooves separating the lateral areas extend forward to the very bases of the first antennae, a condition found in none of the Caliginæ.

The short transverse grooves also which separate the cephalic from the thoracic portions of the lateral areas extend to the very edge of the carapace and form there well-defined notches or incisions. But more than all this, the fusion of the different areas is not so complete as to prevent considerable freedom of motion along the various grooves. This is especially true of the second thorax segment, which,

despite its attachment to the carapace, possesses considerable freedom of motion.

2. It would be the only genus in which all the legs were biramose. This objection has greater value when we find that the third legs, which are always biramose, show a marked resemblance to those of the Euryphorinæ, and are very different from those of the Caliginæ. Krøyer,<sup>a</sup> in his original description of the genus, notes that the first, third, and fourth legs differ markedly from those of the Caliginæ. But he says that the second legs correspond in the smallest details with those of *Caligus*. "Fjerde<sup>b</sup> par Fødder er indtil de mindste Detaillen som has Slaegten *Caligus*."

His statement would have been more accurate had he substituted the genus *Lepeophtheirus* for *Caligus*. In *Caligus* the spines on the outer margin of the exopod in these second legs are large and almost invariably turn inward and run diagonally across the ramus, while in *Lepeophtheirus* they are smaller and are parallel with the margin, as we find them here.

3. The eyes, which are very small and easily overlooked in the adult, are separate, one on either side of the mid-line, and are not fused, as in the Caliginæ.

4. The mouth tube, while it has not become as long and pointed as in some of the Euryphorinæ (*Alecion* and *Gloiopotes*), is yet noticeably longer and narrower than in the Caliginæ, and is also definitely jointed near the base. The side incisions at the joint are deeper than usual, and the corners are more prominent, as was noted by Krøyer. In short, the mouth and the mouth-parts are as symmetrically intermediate between the types of the Caliginæ and the Euryphorinæ as could well be desired.

B. On the other hand, if it were included with the Euryphorinæ—

1. It would still be peculiar in having two free thorax segments and also in the arrangement of the grooves and areas on the dorsal surface of the carapace. While the fusion of the head and thorax segments is not as complete in the Euryphorinæ as in the Caliginæ, it is still thorough enough to effectually prevent any such freedom of movement as we find here.

2. It has no dorsal plates on the free thorax, the genital segment, or the abdomen. This, of course, would not count for much if it were the only difference, but it does contribute materially in the way of cumulative evidence.

3. It would be the only genus in which the larva was attached during the chalimus stage by means of a frontal filament like those found

<sup>a</sup> Om Snyltekrebsene, især med Hensyn til Danske Fauna, 1838, pp. 32-34.

<sup>b</sup> He calls the first maxillipeds the "first pair of legs," and hence his "fjerde," or fourth pair, would be really the second swimming legs.

in the *Caliginæ*. This is the most important difference, and furnishes, in the author's opinion, a sufficient reason for excluding the genus from the *Euryphorinæ*.

Genus TREBIUS Kröyer.

Carapace usually oval or elliptical and quite strongly arched dorsally. Third thorax segment short and wide; free, but attached to the posterior margin of the carapace in such a way as to complete a thoracic area somewhat like that in the *Caliginæ*. The grooves, however, are arranged differently and consist of a semiellipse at the posterior end of the carapace, a longitudinal groove on either side extending forward to the lateral sinus behind the base of the first antenna, and a transverse groove extending outward on either side from this longitudinal groove to a notch in the edge of the carapace.

The body of the copepod is capable of more motion along these grooves, particularly the semiellipse, than in the genera of the *Caliginæ*.

Fourth segment more or less elongate, abruptly narrowed anteriorly and posteriorly, with its sides projecting strongly at the center over the bases of the fourth legs.

Genital segment considerably smaller in the male and showing two pairs of legs, one on the sides and the other at the posterior corners. Egg-strings as in *Caligus*; eggs small and numerous.

Mouth-tube long and wide and distinctly hinged at the center; mouth-opening terminal and heavily fringed with hairs.

Mandibles slender, slightly curved, and toothed on the inner margin only. Second maxillæ long and pointed, articulate; either simple or slightly bifurcate at the tips. First maxillipeds stouter and the second pair weaker than in the *Caliginæ*, thus eliminating much of the difference between the two appendages.

(*trebius*, the name of a parasite in Juvenal, Satire V.)

ONTOGENY.

The life history of this genus is very similar, so far as known, to that of the *Caliginæ*. The following summary is taken from the works of various authors, chiefly Kröyer (1863) and Olsson (1869), supplemented by original research:

Nothing is known of the nauplius and metanauplius stages; the youngest individual so far obtained was a small chalimus found by Kröyer amongst the preserved material he examined. But this chalimus is so similar to those found among the *Caliginæ* as to leave little doubt that the earlier stages are equally similar, and that when found they will differ simply in detail and not in any of the essential characters.

Kröyer's chalimus specimen (fig. 1) was about 1.5 mm. long and of an elongated oval form. Carapace two-fifths the entire length, as wide as



long, evenly rounded anteriorly, slightly narrowed and emarginate posteriorly. The dorsal surface of this carapace shows no grooves at all, which would naturally be expected since there is no fusion as yet between the head and thorax, neither have the segments formed any lobes or processes.

Frontal plates small but distinct; antennæ slender but proportionally long, their tips reaching beyond the lateral margins of the carapace. Eyes small, some little distance apart on either side of the mid-line and just in front of the center of the carapace. This separation of the eyes from the earliest known stage is a notable departure from the condition in the Caliginæ. In the latter the eyes are fused from the beginning of the metanauplius stage<sup>a</sup>. Indeed in the preceding nauplius stage whenever the eyes are visible they are fused on the mid-line<sup>b</sup>. This suggests that the characteristic median eye of the nauplius larva may be a more complete fusion of two eyes.

The first three segments of the thorax are free, of about the same length, but diminish a little in width from in front backward.

The first one is the same width as the carapace, and each of the three carries a pair of more or less rudimentary swimming legs. Krøyer represents all three pairs as uniramous, the first and third pairs two-jointed, the second pair three-jointed.

He says nothing about these swimming legs in the text, so that we

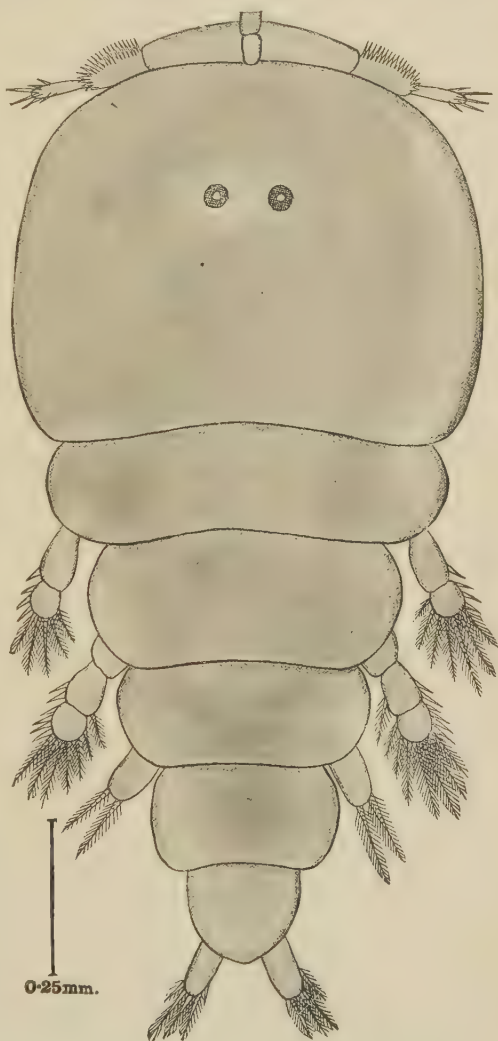


FIG. 1.—CHALIMUS OF TREBIUS CAUDATUS (AFTER KRØYER).

<sup>a</sup> Proc. U. S. Nat. Mus., XXVIII, 1905, p. 541, fig. 40.

<sup>b</sup> Idem, fig. 39.

are compelled to fall back upon his figure, which is a fairly good one, for our information. That the three pairs are all uniramous, is extremely improbable, and Olsson's description must be received as much the more accurate.

This latter author says, in speaking of the smallest chalimus found (0.8 mm. long), that it possessed two pairs of swimming legs, each with a single basal joint, and two one-jointed rami.

A little larger specimen (1.2 mm. long) showed vestiges of the third legs, while a larva two millimeters long had all the "abdominal feet," but the rami, except those of the first pair, were not jointed.<sup>a</sup> This corresponds with the condition in the Caliginæ and Euryphorinæ and hence is what would naturally be expected for the present genus.

The fourth segment is still fused with the genital segment, and the two bear no appendages. The abdomen consists of a single short and wide joint bearing the small and elongate anal laminae. These last two joints also diminish regularly in size from the third thorax joint, so that the whole posterior body of the chalimus tapers evenly toward the abdomen.

The second antennæ are noticeably elongated and slender; the two joints are about the same size, while the terminal claw is short and abruptly bent over toward the second joint into the form of a sharp hook. Nothing is said of the other appendages save that the mouth-parts have the same general shape and arrangement as in the adult. In fact they furnish in this one of the best evidences of the identity of the larva.

In this young chalimus, for such it is proved to be by the stump of a frontal filament still attached to the frontal plates, the transverse groove between the head and first thorax segment is perfectly straight, while that between the first and second thorax segments is slightly curved forward at the center.

This forward curve is increased in later development, so that on a larva 2.5 mm. long it projects quite a little way into the posterior portion of the carapace (fig. 2).

This larva and the one following, the next two stages known, were found by the author among some adults of *Trebius exilis*, a new species obtained by Prof. W. A. Herdman from *Rhinoptera javanica* at Ceylon. The lateral processes on the sides of the second segment in this larva are nearly as large as the posterior lobes of the carapace. The third segment is considerably narrower than the second, but is still wider than it is long. The fourth and genital segments have been separated; the former has been elongated until it is now longer than wide and is of a broad spindle shape, widest at the center.

The genital segment has a curious shape; each of the posterior angles projects strongly sidewise, is well rounded, and armed with two

<sup>a</sup> Olsson, Prodröms faunæ Copepodorum parasitantium Scandinaviæ, 1869, p. 15.

stout spines. This makes the segment nearly twice as wide across its posterior margin as at the anterior end.

In fig. 2 a short segment can be seen immediately behind the fourth segment and in front of the genital segment proper. This short segment bears the rudiments of a pair of legs at its posterior corners, but it is not fully separated from the genital segment. There is simply the position of these rudimentary legs and a deep lateral incision on either side just behind them to indicate the posterior limit of the segment. There is no groove across the median line on either the dorsal or ventral surface. These rudimentary fifth legs subsequently disappear entirely in the female, but are retained in the male, and appear in the adult on the sides of the genital segment two-thirds of its length from the anterior end.

In other words, what is ordinarily termed the genital segment is really a fusion of two segments, the fifth and sixth, of which the fifth forms more than half.

The abdomen has lengthened and become longer than wide; it also is slightly wider at its posterior end, and the anal laminæ have become twice as long as wide.

All four pairs of legs are now present and all are biramose, but the rami have only two joints instead of three.

The frontal plates have thickened considerably, but in the sinus between them can still be seen the remnants of the frontal filament. The antennæ are relatively much shorter and thicker than before, and

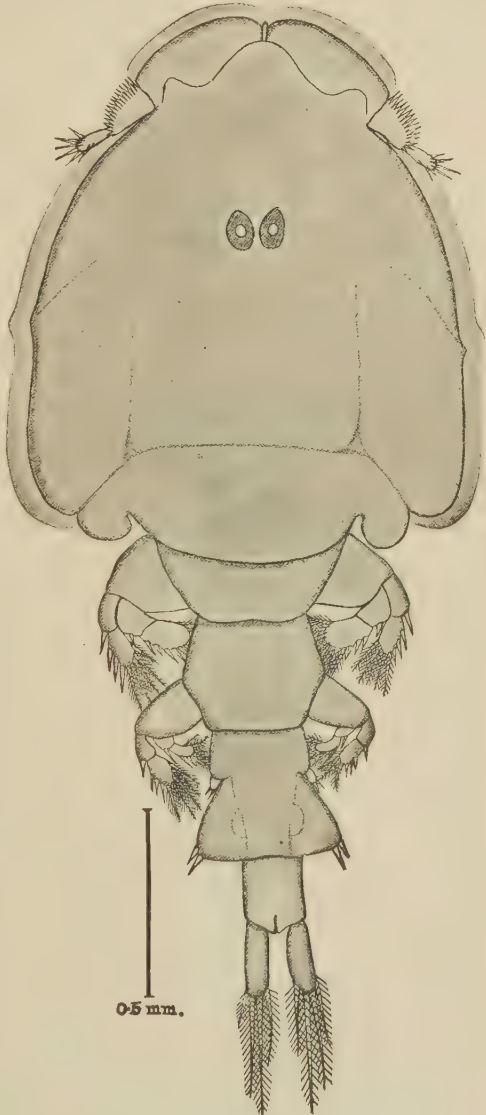


FIG. 2.—LARVA OF TREBIUS EXILIS, 2.5 MM. LONG.

are appressed more closely to the margin of the carapace. The eyes have approached nearer together but are still not fused, although they are nearly in contact with each other. The dorsal surface of the carapace shows the single posterior groove between the first and second segments, the beginnings of the lateral longitudinal grooves, and the

transverse grooves dividing the lateral areas. Otherwise the surface is smooth and without markings. The general appearance of this larva is so radically different from that of the adult that at first it was supposed they were separate species. But there is no difference to be detected in any of the appendages save the swimming legs, where, as already stated, the rami have but two joints instead of three.

This, however, is only another evidence of the larval condition and not one of specific difference. Kröyer, in his second account of the genus, called attention to the very diverse modifications of form among the females, which he declared could be referred with certainty<sup>a</sup> to the different degrees of development. He also inferred that the females of *caudatus* do not reach full maturity until they are at least 85 per cent of their ultimate size. Such an inference is well substantiated by the developmental forms here presented.

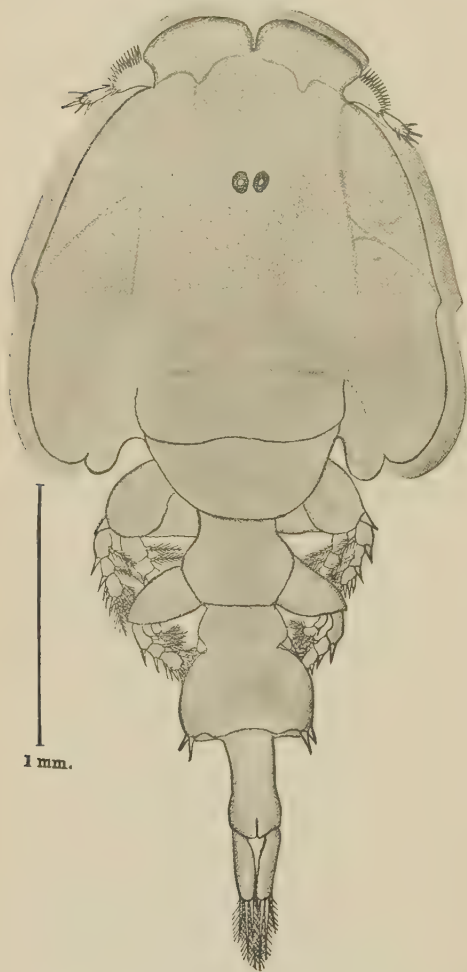


FIG. 3.—LARVA OF TREBIUS EXILIS, 3.5 MM. LONG.

Another young female, the second of the larvæ obtained from Ceylon, measured 3.5 mm. in length. At this stage the carapace has enlarged even more, being now five-sevenths of the entire length (fig. 3). The second thorax segment has widened with the carapace and also shortened somewhat. It still projects with a shallow and uniform curve into the posterior portion of the carapace and is nearly

<sup>a</sup> Bidrag til Kundskab om Snyltekrebsene, 1863, p. 149.



as freely movable as any of the other thorax joints. The longitudinal and transverse grooves are also fully formed, so that the dorsal surface presents the same areas as in the adult.

The third and fourth thorax segments have changed but little; the fourth projects farther proportionally over the bases of the fourth legs. There is a similar semiseparation of a fifth segment at the anterior end of the genital segment, and the rudiments of a fifth pair of legs can still be seen at its posterior corners. Neither the segment nor the legs are as prominent as in the preceding stage, and in all probability they soon disappear.

But a radical change has taken place in the genital segment itself. This has widened into a broad acorn shape, as wide anteriorly as posteriorly, with the posterior corners projecting slightly backward and showing the sixth legs plainly at their tips. The abdomen is narrow with straight sides; the anal laminae are very narrow and nearly as long as the abdomen itself, each armed with 4 long plumose setae.

The appendages have now assumed their final form; the second antennae are developed into powerful prehensile organs with long and stout terminal claws. The first and second maxillipeds are about the same size, and neither of them large enough to be of any real service for prehension. The rami of the swimming legs have all become clearly three-jointed, except the endopods of the fourth legs, which in this species remain two-jointed in the adult, and they function as powerful locomotor organs. The transition from this stage to the adult is very slight and consists chiefly in the changes produced in the genital segment by the maturation of the eggs, the consequent enlargement of the oviducts, and the elimination of all traces of a separation into fifth and sixth segments.

The rudimentary fifth legs entirely disappear in the female, and there is absolutely nothing left to indicate that the genital segment contains more than a single thorax joint.

Kröyer<sup>a</sup> notes that the form of the genital segment in all his specimens of females differs from that of the male, and keeps a sexual peculiarity through all its changes, going over gradually from an elongate-angular form into a flask shape.

And he adds: "How far females younger than those I have examined may present on this point an approximation to the males, I may leave to the decision of future investigators."

In the present instance the larval females, which are younger than any he obtained, do not show "an approximation to the male," but even the youngest of them has the distinctive angular form of its own sex.

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<sup>a</sup> Bidrag til Kundskab om Snyltekrebsene, 1863, p. 152.

## ANALYTICAL KEY TO SPECIES.

1. Abdomen distinctly shorter than the genital segment; furca three or four times as long as wide ..... *exilis* Wilson, 1906, p. 678.
1. Abdomen much longer than the genital segment; furca only twice as long as wide ..... 2
2. Carapace wider than long, semilunar; furca with slender elongate branches and small foramen; abdomen of female two-jointed, joints equal.  
*tenuifurcatus* Rathbun, 1887, p. 679.
2. Carapace longer than wide, elliptical; furca with short, stout branches and very large foramen; abdomen of female three-jointed, joints diminishing in size toward the tip ..... *caudatus* Kröyer, 1838, p. 681

## TREBIUS EXILIS Wilson.

Plate XV, figs. 1 to 7; figs. 2 and 3, pp. 675 and 676.

*Trebus exilis* WILSON, 1906, p. 194, pl. II, figs. 20-33.

*Female*.—Carapace ovate, one-seventh longer than wide, narrowed anteriorly, and well arched. Transverse grooves separating the cephalic and thoracic portions of the lateral areas situated far forward, leaving the thoracic portion much the longer of the two. Eyes small, purplish red, and one-third the distance from the anterior margin. Frontal plates better developed than in either of the following species, but still less than half the width of the carapace. Third thorax segment but a little wider than the fourth and considerably shorter; fourth segment strongly widened between the bases of the fourth legs. Genital segment almost a perfect ellipse, but contracted anteriorly into a narrow neck where it joins the fourth segment. It is more than three-fifths the size of the carapace, and shows neither spines nor legs at the posterior corners in dorsal view.

Egg strings about the same width as the abdomen, but from two and a half to three times its length, thus contrasting sharply with those of *caudatus*. Eggs of medium thickness, 40 to 50 in each string.

Abdomen, even including the anal laminae, at least one-half shorter than the genital segment; made up of a single joint, and of the same diameter throughout. Anal laminae elongate, more than twice as long as wide, each armed with 4 long plumose setae.

Second antennae large and stout; the terminal claw wider at the base than in *caudatus* and relatively as long. But the abrupt bend is at the center instead of near the tip, and this makes the claw appear shorter.

First maxillae straight, small, and weak, the tip not much longer than the enlarged base, and the whole appendage fused to the ventral surface of the carapace. Second pair two-jointed, the basal joint fused to the carapace and carrying at its center near the terminal joint a good-sized rudimentary exopod. The terminal joint (endopod) elongate-triangular and extending for half its length beyond the tip of the mouth tube. This endopod is bluntly pointed without any trace of

bifurcation. Maxillipeds as in the other species. Furca narrow, the length four times the width, the branches short, simple, divergent, pointed, leaving a V-shaped sinus only one-fourth or one-fifth the entire length. Swimming legs all biramose, and the rami three-jointed except those of the first pair and the endopods of the fourth pair, which are two-jointed. Fifth legs small and close to the lateral margins on the ventral surface of the genital segment a little in front of the posterior corners. Cement glands wide and reaching forward almost to the anterior end of the segment; their component cells narrow.

Total length, 5.75 mm. Length of carapace (including third thorax segment), 2.5 mm. Length of genital segment, 1.57 mm.; of the abdomen, 1.1 mm.; of egg strings, 3.1 mm. Width of carapace, 2.1 mm.

*Male*.—Carapace like that of the female but relatively larger, being more than half the entire length. Frontal plates wide and strongly arched anteriorly; eyes small but distinct. Second and third thorax segments relatively wider than in the female; fourth segment the same width as the genital segment, and only a trifle longer than the second and third segments. Genital segment elliptical-oblong, one-fourth longer than wide and not quite one-fifth the entire length. Both the fifth and sixth legs are visible dorsally, the former on the lateral margins at about the center of the segment, the latter at the posterior corners. Abdomen two-jointed, joints equal, but the two together at least one-half shorter than the genital segment as in the female. Anal laminae narrow but nearly as long as the entire abdomen, each tipped with four plumose setae, which in turn are as long as both the abdomen and the laminae. Appendages as in the female, except that the second antennae are sometimes branched as in the males of the Caliginæ.

Total length, 2.75 mm. Length of carapace (including third thorax segment), 1.4 mm.; of genital segment, 0.5 mm.; of abdomen, 0.6 mm. Color of both sexes (preserved specimens) a uniform yellowish white without pigment.

(*exilis*, slender, graceful.)

Through the courtesy of Prof. W. A. Herdman, of the University of Liverpool, the United States National Museum collection contains a single cotype specimen of each sex of this species (Cat. No. 32723, U.S.N.M.) which were taken from *Rhinoptera javanica* at Ceylon.

#### TREBIUS TENUIFURCATUS Rathbun.

Plate XV, figs. 8-10.

*Trebius tenuifurcatus* RATHBUN, 1887, p. 559, pl. xxix, figs. 1-3.—BASSETT-SMITH, 1899, p. 462.

*Female*.—Carapace horseshoe-shaped, wider than long, and, including the third thorax segment, about one-third of the entire length.

Frontal plates narrow and not quite half the width of the carapace; lateral lobes reaching back to the posterior margin of the first free thorax segment; no eyes visible.

Transverse grooves separating the lateral areas situated far back, leaving the thoracic portion shorter than the cephalic, as in *caudatus*. These grooves do not make a prominent notch, however, at the edge of the carapace, as in the other two species. But this may well be the fault of the preservation of the specimen, since it has evidently shrunk considerably in the alcohol.

The first free (third) thorax segment is wide and short, while the fourth is longer and narrower and subquadrilateral in outline, showing no increase in width between the bases of the fourth legs. The genital segment is flask-shaped, but its exact proportions and size can not be definitely determined, in consequence of an injury, and also because it is entirely covered with Protozoa. It is certain, however, that it is more than half the size of the carapace, probably fully three-fifths; that the posterior corners are well rounded, and that they do not show any signs of rudimentary legs or spines, as in *caudatus*. In this respect it is similar to *exilis*.

The abdomen is almost linear, nearly twice the length of the genital segment and more than eight times as long as wide.

It is jointed once at the center, the joints being thus of the same length, and the terminal one bearing a pair of short and narrow anal laminae.

The appendages are very similar to those in *caudatus*, the chief difference being that they are more slender and comparatively longer. In the second antennae the basal joints are more slender than in either of the other two species, but the long distal claw is considerably stouter, being fully half as wide as the basal joints. The first maxillae have a swollen circular base and a long terminal portion less than one-fifth the width of the base and bent abruptly at a right angle near the center. The furca is long and slender, with linear rami, which are nearly parallel and more than twice as long as the basal portion. The foramen is small and almost circular.

The swimming legs are of the usual pattern, both rami of the fourth pair being three-jointed.

Total length 6.5 mm. Length of carapace, including the third thorax segment, 2 mm.; of the fourth segment, 0.5 mm.; of the genital segment, 1.5 mm.; of the abdomen, 2.5 mm. Width of carapace, 2.4 mm.

Color of the preserved specimen a darker yellow than in *caudatus*, without any pigment.

(*tenuifurcatus*, *tenuis*, slender, and *furcatus*, furnished with a furca.)

This species was founded by Rathbun in 1887 upon a single poorly preserved specimen. As a usual thing under such circumstances it is



better to wait for further material before establishing a new species. But after a personal examination of the present specimen its identity as a new species is so apparent that the author considers Rathbun fully justified in making of it a new species without waiting for more specimens.

It is Cat. No. 6193, U.S.N.M., and was taken from a sting ray captured in Vineyard Sound, Massachusetts, by the United States Fish Commission in 1871.

#### TREBIUS CAUDATUS Kröyer.

Plate XV, figs. 11-13; Plate XVI, figs. 14-22; fig. 1, p. 673.

*Trebius caudatus* KRÖYER, 1838, p. 30, pl. I, fig. 4.—M. EDWARDS, 1840, p. 458.—BAIRD, 1850, p. 280, pl. XXXIII, figs. 3 and 4.—KRÖYER, 1863, p. 149, pl. x, fig. 1 a-k.—OLSSON, 1869, p. 14, pl. I, figs. 3 and 4.—THOMPSON, 1888, p. 69, pl. II, fig. 10.—T. SCOTT, 1900, p. 155, pl. VI, figs. 20-26.

*Female*.—Carapace orbicular, a little longer than wide, somewhat contracted anteriorly and well arched dorsally. Frontal plates narrow and only two-fifths the width of the carapace. Transverse grooves separating the cephalic and thoracic portions of the lateral areas far back, leaving the thoracic portion much the shorter of the two. Eyes not showing in the adult but visible in the young as two purplish-red spots, not fused but close together and about one-third the distance behind the anterior margin. Third thorax segment one-half wider than the fourth, but not as long; fourth segment spindle-shaped, being widened considerably between the bases of the fourth legs.

Genital segment enlarged to about three-fifths the size of the carapace, flask-shaped, the anterior end narrowed into a short neck where it joins the fourth segment. The posterior corners are evenly rounded and armed on the dorsal surface with three or four stout, broadly triangular spines which project over the bases of the egg-strings. The latter are usually a little longer and about the same width as the abdomen. Sometimes, as in one of Kröyer's two original type specimens, the egg strings are not as long as the abdomen. Eggs quite small, from 30 to 40 in each string.

Abdomen one-half longer than the genital segment and only three-eighths as wide; three-jointed, the joints diminishing greatly in length and slightly in width from the base toward the tip.

Anal laminae short and narrow, each armed with four small plumose setae, of which the outer and inner ones are the shortest.

Second antennae with the two basal joints thick and stout, the terminal claw long, slender, and not more than one-fifth as wide as the basal joints. First maxillae long for a female, thick and stout, with the base swollen into a transversely elliptical form. Second maxillae elongate-triangular, with the basal joint fused to the ventral surface

of the carapace and armed with a rudimentary exopod, as in *erilis*. The endopod in the present species, however, is bifurcate at the tip; the inner branch slender and pointed, the outer one twice the length of the inner, stout, and bluntly rounded at the end.

Furca small, the length only twice the width; the rami simple, short, stout, bluntly rounded, and less than half the length of the basal portion. The latter is elliptical or oval with a large foramen of the same shape.

The swimming legs are all biramose, the rami of the first pair two-jointed, of the other pairs three-jointed. Fifth legs invisible dorsally, but consisting of a small papilla at each posterior corner of the genital segment on the ventral surface.

Oviducts not much coiled in the genital segment; cement glands of the usual shape, parallel with each other, and reaching well forward toward the anterior margin of the segment; the gland cells short and transversely linear.

Total length, 9 mm. Length of carapace, including third thorax segment, 3 mm.; of genital segment, 2.33 mm.; of abdomen, 3 mm.; of egg-strings, 2.8 to 4 mm. Width of carapace, 2.5 mm.

Alcoholic specimens a dull yellowish horn color without any traces of pigment.

(*caudatus*, tailed, alluding to the great length of the abdomen.)

*Male*.—Carapace orbicular half the entire length, and fully as wide as long; only slightly narrowed anteriorly. It is even more strongly arched than in the female and, as Kröyer says, may be called "hunch-backed," since the posterior portion falls away rapidly. The markings and grooves are similar to those on the female. The third thorax segment projects behind the lateral carapace lobes considerably farther than in the female; it is twice the width of the fourth segment, but about the same length. The fourth segment is spindle-shaped and about the same width as the genital segment.

The latter is proportionally very small, less than one-fifth the entire length, a little longer than wide, with the sides and posterior end evenly rounded, while the anterior margin is squarely truncated. Abdomen narrow and a little longer than the genital segment, made up of two joints about the same width, but the terminal one one-third longer than the basal.

Anal laminae one-quarter the length of the abdomen, slightly divergent, and each armed with five plumose setae, the inner of which is the longest and about three times the length of the lamina. Appendages as in the female. In speaking of the second maxillipeds, Kröyer says that he is "certain they are three-jointed since the base of the claw where the seta goes out shows a distinct jointing." This does not seem probable, and none of the specimens examined by the author show it.

The three terminal claws on the end of the exopod of the first swimming legs are toothed, the first one along the posterior margin, the other two along both margins.

The genital segment shows two pairs of rudimentary legs on its ventral surface, the first pair two-thirds of the length from the anterior end and close to the lateral margins, the second pair at the posterior corners.

The semen receptacles are sausage-shaped, the posterior portion enlarged into a more or less spherical sac, the anterior part made up of the coiled duct.

Total length, 4.5 mm. Length of carapace, 2.3 mm.; of genital segment, 0.8 mm.; of abdomen, 1.10 mm. Width of carapace, 2.8 mm.; of genital segment, 0.6 mm.

Color as in female. The United States National Museum collection includes a single lot of this species, numbering eight specimens, which were taken from a skate off the coast of Shetland (Cat. No. 8033, U.S.N.M.), and are all finely preserved.

This is Krøyer's original type species of the genus; he described the female in 1838 and the male in 1863.

It is a very common species and has been described by many zoologists since Krøyer's day, each in his turn adding something to the details already known. The present account has collected all these details and supplemented them where lacking, and also supplies several new figures, bringing the account of the species up to date. Certain of the figures have been placed on Plate XV in order to facilitate a comparison between the three species and thus bring out more clearly the specific differences. The three species have been under the author's observation simultaneously, and there can be no doubt of their validity.

#### Subfamily EURYPHORINÆ.

Sexes similar as in the Caliginæ. Carapace broad and compressed, made up of the three anterior thorax segments fused with the head. The fusion, however, is not always as complete as in the Caliginæ, but shows a marked transition in the different genera. In *Alebion* and *Gloiopotes* the three first segments are fully blended with no grooves between them. In *Euryphorus* and *Dysgamus* the second and third segments are fused *inter se*, but are well separated from the first, while in the new genus *Dissonus* all three thorax segments are free and as completely separated as in the Pandarinæ.

Frontal plates well defined, but never furnished with lunules. The fourth thoracic segment small, free, and furnished in the females with a pair of dorsal plates which usually overlap the following (genital) segment. This latter is large and nearly always lobed posteriorly; it is covered in *Euryphorus* with a large membranous wing made up of

a pair of fused dorsal plates, but is without any covering in the other genera.

Abdomen two-jointed, elongated; the first joint much enlarged in *Euryphorus* and furnished with a pair of lateral wings; in the other genera without wings or plates.

Second maxillæ showing a marked transition from a simple, pointed form in *Cyligeria* and *Elytrophora* through a blunted, biramose shape in *Gloiopotes* into a flattened lamina in *Alebion*, very similar to that found in the Pandarinæ.

All four pairs of thoracic legs usually biramose and armed with plumose setæ, the first pair in *Caligeria* and the first and fourth pairs in *Gloiopotes* uniramose. The remaining appendages and anal laminae as in the Caliginæ. In development the young are never attached by a frontal filament, but by the enlarged second antennæ.

#### ONTOGENY.

The life history of the genera belonging to this subfamily is very similar to that in the Caliginæ, but differs in several important details, which differentiate the two subfamilies clearly.

The flattening of the eggs in the egg-strings, the symmetrical arrangement of all the embryos in the same string, and the change of color due to the increase of pigment with advancing development are the same as already described. About ten weeks are required for development in such species as have been observed, and all the eggs in a given string hatch at practically the same time. The issuing nauplius is similar to those of the Caliginæ and differs from them chiefly in one particular.

It is elongate in form, the two ends being about the same size and evenly rounded; there is the same eye-spot and supracæsophageal ganglion; the three pairs of appendages, the first antennæ uniramose and terminating in two long plumose setæ, the second antennæ and mandibles biramose, the exopod four-jointed, each joint bearing a long plumose seta, the endopod one-jointed and terminating in a single seta.

The anterior part of the body is transparent and shows the muscles which move the appendages, while the posterior part is filled with yolk granules which render it opaque.

But when we examine the balancers near the posterior end of the body we find them quite different from those which characterize the Caliginæ. Instead of a cylindrical base and a broad spatulate tip we have here a longer and more slender appendage tapering directly from base to tip like a very long and acuminate spine. Usually also they stand out at right angles to the central axis and are slightly curved forward.



We find here the same variation in the color and pattern of the pigment spots as in the previous subfamily, and they furnish equally good means of identification.

It is even more difficult to hatch these nauplii and rear them through successive moults than it was in the case of the Caliginæ. This is due to several causes.

Both sexes of the adults in the genus *Alcbion* are very active when kept in aquaria, swimming about restlessly all the time. And they have the same pernicious habit as *Caligus* of crawling up out of the water as far as they can get and remaining there until dead and dried. Again with *Caligus*, if the female's egg-strings were nearly or fully ripe, she usually refrained from this suicide until after the nauplii had emerged. But the ripeness of the eggs seems to make no difference with *Alcbion*, and as a consequence it is very seldom that a brood of nauplii can be obtained in captivity. The explanation of this conduct may possibly be found in the fact that the genera belonging to this subfamily are extremely sensitive to temperature changes in the water. A rise of only a few degrees is quickly fatal, and it usually happens that nearly all the specimens obtained during the hauling of a fish net are dead before reaching the laboratory, even though they were placed in fresh water and in an absolutely clean receptacle. About the only way they can be kept alive is to change the water so frequently that there can be practically no rise in the temperature. But even then they do not live as long as *Caligus* or *Lepeophtheirus*, and make very poor aquarium material. This is especially true of the adult females; the males and young females are rather more hardy.

From this it would naturally be inferred that the life-history is a difficult matter to obtain, but there is still a chance of success because, as soon as the nauplius moults into the metanauplius, it fastens itself at once to its host and there remains until fully developed. Hence a careful search of the host at the proper time is almost sure to yield development stages of the parasite. Fortunately the hosts for the two species of *Alcbion* here presented are the smooth dogfish and the sand shark, two of the most common fish along the Atlantic coast. The eggs hatch during the latter part of June and the first of July so that the best time to look for the development stages is during the first two weeks in the latter month. They may be found anywhere upon the shark's body, but seem to prefer the mid-line of the dorsal surface just in front of the dorsal fins. Frequently they are huddled together in clusters and are so close to one another that there is not room for them all to rest against the skin of the host, and some are obliged to stand out from the surface at a greater or less angle. In such instances they resemble a chalmus very closely since the only part of their body in actual contact with the host is the pair of long second antennæ, and they float out in the water much as though fastened by a short frontal

filament. In this condition they could easily be mistaken for chalimi, and no doubt have been before now.

From one small shark on July 4, 1904, a strip of skin an inch long and half an inch wide, taken from just in front of the posterior dorsal fin, contained thirty-five of these embryos.

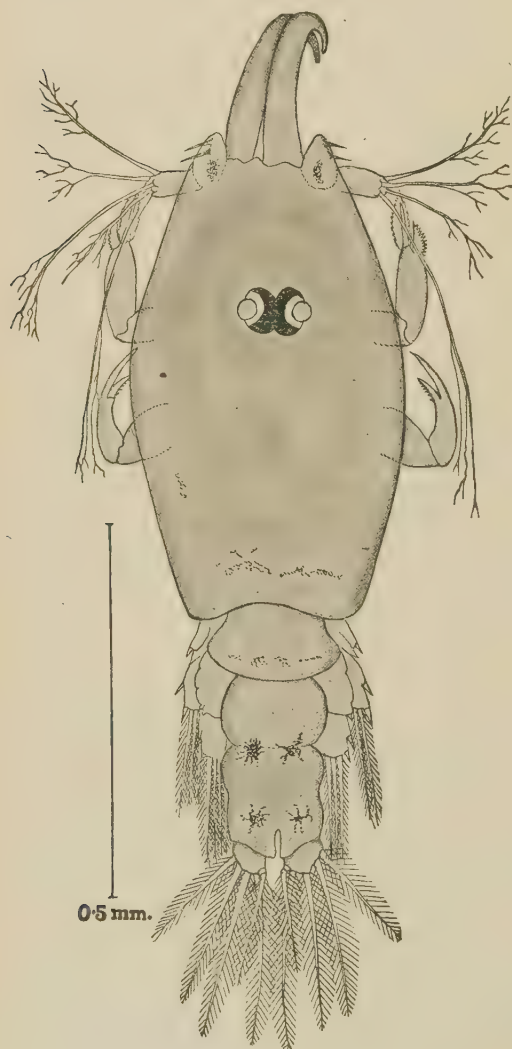


FIG. 4.—THE METANAUPLIUS OF ALEBION GLABER.

thoracic segment. This fusion is more complete than it was in the metanauplius of the Caliginæ, and constitutes a noticeable difference between the two subfamilies.

In this particular, then, the *Alebion* metanauplius is as far advanced as the chalimus of the Caliginæ, and exhibits the first step toward

On removing them from the shark's body and examining them under magnification they are found to resemble a chalimus quite closely in their structure and in the number and arrangement of their appendages. The essential points in which they differ are the entire lack of a frontal filament, which materially alters the form of the frontal plates and the structure of the second antennæ. In this bunch of thirty-five were found all stages of development, from a metanauplius just attached up to larvæ ready to molt into the adult form.

The metanauplius (fig. 4) is quite similar to that of *Caligus* and *Lepeophtheirus*, so nearly like them as to be readily recognized and yet so different that there can never be any danger of confusion. The carapace is spindle-shaped, narrowed both anteriorly and posteriorly, and consists of the head fused with the first

that precocious development which characterizes the more degenerate families of these parasites.

This is important in its bearing upon degeneration, since it is the very first evidence to be obtained from the development stages. And its value is enhanced from the fact that it occurs in a species whose adult form shows no appreciable diminution of bodily functions or morphology. The adults of both sexes in this genus swim as freely and as actively as any *Caligus*. Their fourth swimming legs, to be sure, have been reduced to mere stumps, and the fourth segment, which carries them, is covered by a pair of small dorsal plates. But, even in this condition, they are about as serviceable as the corresponding members in *Caligus*; that is, they are of no real service in either case so far as can be determined.

The eyes are situated well back toward the center of the carapace and are relatively very large. The pigment is not as extensive as in the *Caliginæ*, the lens being surrounded by a large, clear area. Over the dorsal surface also, in place of the broad lateral pigment lines and the large area in front of the eyes, we find only isolated pigment spots and very few of them. There is a single small spot in the frontal plate on either side at the base of the first antenna and a narrow line across the posterior end of the carapace near the margin.

There is a similar narrow line across the posterior margin of the first free segment, a pair of large spots in the groove between the second free segment and the abdomen, and another pair of spots at the posterior end of the abdomen over the bases of the anal laminae. This metanauplius, therefore, has very little pigment, while the same stage of development in the *Caliginæ* was highly pigmented.

The carapace is followed by two free thorax segments and the abdomen; only the first of the free segments bears swimming legs. The abdomen at this stage is really a fusion of the fourth thoracic, the genital and abdominal segments, the two former being not as yet differentiated. It is as wide as the last thorax segment and terminates in two rather short anal laminae, each armed with five plumose setae.

The first antennae are two-jointed, the terminal joint bearing remarkably long and branched setae, which are not feathered as in the *Caliginæ*. These setae are remarkable in several particulars among those of all the parasitic copepods thus far examined. They are longer than even the plumose rowing setae on the second antennae and mandibular palps of the *Argulus* larva. They extend outward in every direction like ordinary antennal setae, but instead of being plumose they are dichotomously branched toward the tips and thus terminate in a flattened web or mat very similar to that formed by certain algae. Evidently they have retained much of their old locomotor function which they possessed in the nauplius stage.

In all the specimens obtained the basal joint of these first antennæ was folded over beneath the ventral surface, as shown in the figure. That this is the normal attitude and not a folding due to pressure was proved by examining some in an open-watch glass, and by the fact that many of the larvæ in the subsequent chalimus stage showed the same folding.

The second antennæ, unlike the first, have entirely lost their locomotor function and have become prehensile (fig. 11). Each now consists of a long and stout basal joint, extending straight forward beyond the anterior margin of the frontal plate, and an elongated slender terminal claw, which is bent over ventrally into a half circle. These second antennæ extend in front

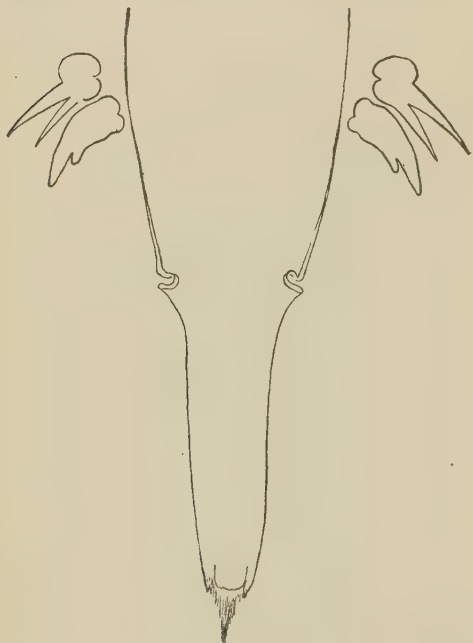


FIG. 5.—MOUTH AND SECOND MAXILLÆ OF THE METANAUPLIUS OF ALEBION GLABER.

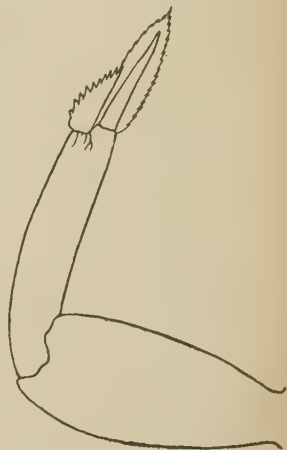


FIG. 6.—FIRST MAXILLIPED OF THE METANAUPLIUS OF ALEBION GLABER.

of the carapace a distance equal to about half the length of the latter. And when driven into the skin, the claws afford a powerful hold and effectually protect the larva against removal by friction or similar cause.

The mouth (fig. 5) has developed into a long proboscis hinged near the center, inside of which, at the very tip, can be seen the mandibles. The mouth opening is terminal, somewhat elongated, and surrounded by a fringe of long hairs. On either side of the mouth tube at its base are the second maxillæ, which at this stage consist of two entirely separate rami of about the same size. Of these the endopod is short and stout and slightly bifurcate at the tip, the outer branch being considerably longer and larger than the inner. The exopod is made up of two diverging slender spines joined together at the base. In this



metanauplius stage, therefore, the two rami of the second maxillæ are equally developed, and there is no indication of the subsequent difference between them. But we shall find a marked change in the chalimus stage.

The first maxillipeds (fig. 6) are two-jointed with the joints about the same length. The basal joint, however, is stout, while the terminal one is slender and ends in two spines, the inner of which is twice the length of the outer.

The inner spine is also slender and has a toothed membrane along both its inner and outer margins; the outer spine is triangular, strongly flattened, and toothed along the outer margin only.

The second maxillipeds (fig. 7) have a very stout basal joint, while the terminal claw is slender, apparently three-jointed, and has an auxiliary spine on the inner margin of the second joint, this spine being toothed.



FIG. 8.—THE FIRST SWIMMING LEG OF THE METANAUPLIUS OF ALEBION GLABER.

a basilar chitin plate. The one connecting the first pair is transversely oblong with a small posterior margin, while that connecting the second pair is horseshoe-shaped and of about the same width and length (fig. 9). The horseshoe opens toward the posterior end of the body and its



FIG. 7.—SECOND MAXILLIPED OF THE METANAUPLIUS OF ALEBION GLABER.

The swimming legs each consist of a large disk-like basal joint and two one-jointed rami bearing long plumose setæ.

There is a long slender spine at the outer distal corner of the basal joints in each pair. The exopods of the first pair carry three short and stout spines along their outer margins, while the exopods of the second pair carry only two (fig. 8). The endopods of this latter pair, however, carry a smaller spine on their outer margin, while the endopods of the first pair have no spines.

Each of these two pairs of legs is connected across the mid line by

sides are proportionally very wide. The abdomen has a slight constriction on either side near the center, which indicates a division during the next moult, the fourth thorax segment separating and becoming free. There is a deep anal sinus at the posterior end of the abdomen, on either side of which are the anal laminae. These are rather small and each carries five long and stout plumose setae.

This larva is colorless except for the pigment spots already described, but is disappointingly opaque. Total length (including second antennae), 1.1 mm. Width of the carapace, 0.4 mm.

At the next molt these metanauplii change into a stage corresponding to the early chalmus of the Caliginæ.

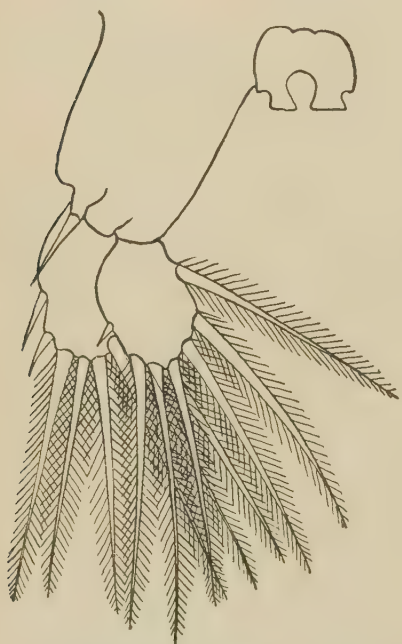


FIG. 9.—THE SECOND SWIMMING LEG OF THE METANAUPLIUS OF ALEBION GLABER.

Although they differ in many important particulars from the form which was taken as the type of the so-called *Chalmus*, and although they even lack a frontal filament which was the essential character of the chalmus, yet it is considered best to retain that name for this stage of development in order to avoid a multiplicity of terms. Accordingly we designate this stage in the Euryphorinæ as the chalmus stage.

The carapace (fig. 10) is oblong, covering more than half the entire body. It is widest at the center and narrowed toward either end, the posterior margin being about the same width as the frontal plates. The latter are thoroughly fused with each other and with the carapace; their anterior margins meet in a rounded projection at the center

instead of an incision, while the lateral margins project on either side far over the basal joints of the first antennæ.

The posterior margin of the carapace is nearly straight through the center, with a short and narrow lobe at either corner which lies closely appressed to the lateral margin of the first free segment. The eyes are situated in about the same relative position as during the metanauplius stage and are fully as large, with prominent spherical lenses. The pigment in them is dark red in color and more abundant than in the previous stage. The pigment also on the dorsal surface has increased considerably in volume, and is found in the shape of spots and lines scattered freely along the sides of the carapace, the free segments, and

the abdomen. This is similar to the condition found in the chalimus of the Caliginæ.

The first thorax segment is still imperceptibly fused with the carapace, but the second and third segments are clearly separated from it, though they have become partially fused *inter se*.

The second segment has become nearly as wide as the carapace and its lateral margins extend out over the bases of the second legs in the form of broad lobes. The third segment is also widened and now bears a pair of swimming legs similar to the first two pairs. The fourth and genital segments still remain fused with the abdomen, but have elongated considerably, while the constriction which indicates the future separation of the fourth segment is more clearly marked.

The anal laminae are longer than in the metanauplius and closer together, but the plumose setae with which they are armed are greatly reduced in size, and there are only three of them on each lamina, all terminal. The other plumose setae of the metanauplius are here represented by two small spines on the outer margin of each lamina.

On comparing this chalimus with that of the Caliginæ we again find evidence of precocious development, this time in the separation of the fourth segment. The second and third segments are fused *inter se* in both subfamilies; in the Caliginæ there is no indication of the separation of the fourth segment, while here that separation is clearly indicated by a well-marked constriction. This would mean very little by itself, but at the next molt, when the fourth segment is fully separated in both subfamilies, we find it without appendages in the Caliginæ but with a pair in the Euryphorinæ.

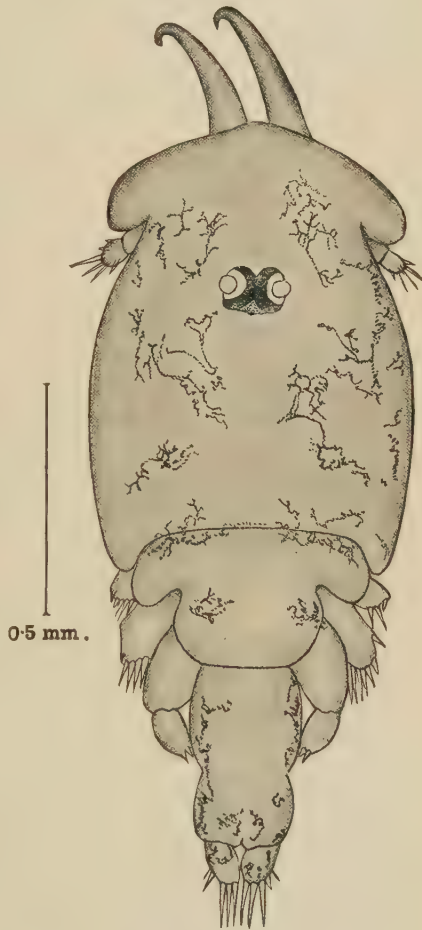


FIG. 10.—THE (FEMALE) CHALIMUS OF ALEBION GLABER.

In the latter case these appendages are very rudimentary, to be sure, but they are all the copepod ever possesses and are as fully developed as in the adult.

Of the other appendages in this *Alebion* chalimus the first antennæ are normal and two-jointed, but the basal joint is nearly concealed in a dorsal view by the projecting margins of the frontal plates. Both joints are plentifully supplied with normal setæ, the long and dichotomously branched forms of the metanauplius having entirely disappeared.

The second antennæ (fig. 11) are like those of the previous stage and continue to serve as organs of attachment by which the larva is fastened to its host. This constitutes the most important difference in the development of the two subfamilies.

In all the genera belonging to the Caliginæ whose larvæ have thus far been obtained, the chalimus and subsequent stages up to the adult form are characterized by the presence of a frontal filament, by means of which the larva is securely fastened.

The remains of this filament may be seen in the young adults of both sexes and of all the genera, and is satisfactory proof of its presence during development even in those forms whose larvæ have never been actually seen.



FIG. 11.—THE SECOND ANTENNA AND FIRST MAXILLA OF THE CHALIMUS OF *ALEBION GLABER*.

In the genus *Alebion*, on the contrary, there is no frontal filament at any period of development, the second antennæ serving as the only organs of attachment up to the adult stage.

The life history of *Alebion* is the only one at present fully known in the subfamily Euryphorinæ, but we have the same evidence here in a negative way that we had positively in the Caliginæ. None of the adults in any of the genera thus far examined show traces of a frontal filament; the younger adults certainly ought to do so, provided such a filament exists during their development.

The first maxillæ are minute and easily overlooked; they are quite close to the margin of the carapace, and have the shape of a comma, the base nearly spherical while the tip is short and blunt.



The second maxillæ are simple and made up of a stout cylindrical base, abruptly rounded and tipped with a short triangular spine (fig. 12). This represents the endopod of these maxillæ as seen in the metanauplius stage; the exopod has even thus early degenerated into the form seen in the adult, a papilla fused with the base of the endopod and carrying two small spines.

The mouth tube is cylindrical and nearly as wide at the tip as at the base; the mouth opening is subterminal (a little ventral), and heavily fringed with hairs. When viewed from the ventral surface the tips of the mandibles can be seen inside the opening. They are slender and two-jointed, the terminal joint only one-eighth as long as the

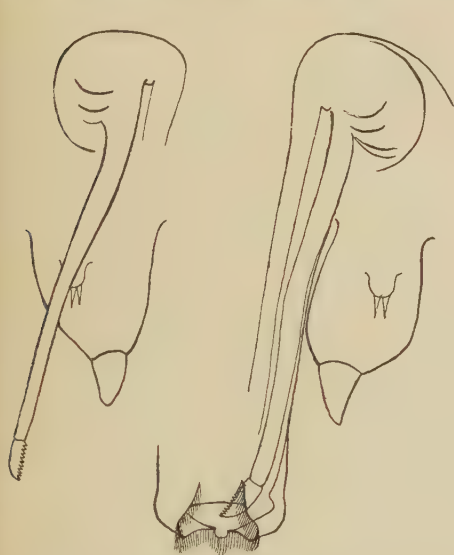


FIG. 12.—THE MOUTH-TUBE, MANDIBLES, AND SECOND MAXILLÆ OF A MALE CHALIMUS OF ALEBION GLABER.



FIG. 13.—THE FIRST AND SECOND MAXILLIPEDS OF A CHALIMUS OF ALEBION GLABER.

basal and minutely toothed along its inner margin, the number of teeth being eighteen or twenty.

The first maxillipeds (fig. 13) are similar to those in the adult, the two joints about the same length, but the basal joint considerably the stouter. Both the terminal claws have a toothed membrane along their inner and outer margins.

The second maxillipeds are short and stout; the basal joint is nearly as wide as long, and is filled with strong muscles; the terminal claw is stout at the base but tapers to a weak tip, not much longer than the accessory spine and only slightly curved.

All three pairs of swimming legs (fig. 14) are biramose and the rami are one-jointed. In the first pair the exopod is as long as the basal

joint and much larger than the endopod; both rami terminate in stout spines, three on the exopod and two on the endopod, with several smaller accessory ones on the outer margins. In the second legs the

two rami are about the same length, broad and disk-like, and much shorter than the oblong basal joint. They also terminate in stout spines, five on each ramus.

In the third legs (fig. 15) the rami are almost exactly like those on the second legs, but the basal joint is very much swollen and has obtained a good start toward the broad lamellar condition of the adult. The exopod terminates in five spines, considerably smaller than those on the second legs, while the endopod has only three. There is no trace of the fourth or fifth legs at this stage of development.

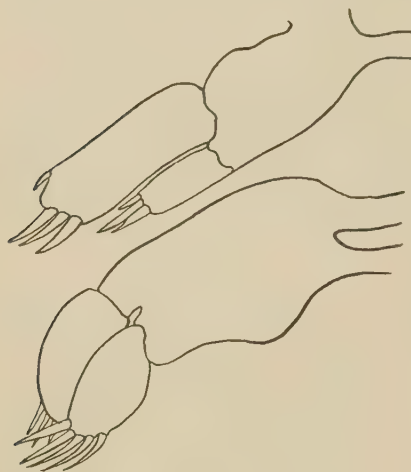


FIG. 14.—THE FIRST AND SECOND SWIMMING LEGS OF A CHALIMUS OF ALELION GLABER.

The young male is very similar to the female, except that the carapace is relatively larger, while the free segments of the thorax are much shorter and the segmentation is more distinct.

The fourth legs (fig. 16) appear toward the close of this chalimus stage, and are distinctly bifurcate at the ends, the two rami being very minute. At the next molt the segment carrying them is fully separated from those which follow it. The posterior portion of the body now rapidly elongates, and the larva advances by several (4 or 5) molts toward its adult form. The genital segment is separated from the abdomen; at first smaller than the latter, as in the Caliginæ, it increases until it becomes much larger. The swimming legs also increase in size, and the large apron of the third pair becomes fully developed across the



FIG. 15.—THE THIRD SWIMMING LEG OF A CHALIMUS OF ALELION GLABER.

posterior end of the carapace, completing with the latter the large sucking disk which is to constitute the chief organ of attachment to the body of the host. At the same time the second antennæ, which have remained as organs of attachment through these early stages,

now decrease in size, become of secondary importance, and finally assume their adult form (fig. 17).

These facts with regard to development settle several questions which have hitherto been in dispute.

In the first place they fully justify the separation of the genus and its near relatives from the Caliginæ on the one hand and from the Pandarinæ on the other, and their establishment as a new subfamily intermediate between these two.

In the genus *Alebion* the fourth legs are so rudimentary that it is impossible to tell from the morphology of the adult whether they are to be regarded as uniramous or biramous.

Consequently it has been difficult to locate the genus with any certainty; Heller placed it among the Caliginæ, with which it is closely affiliated in morphology and habits; Gerstaecker placed it in a subfamily which he called the Nogagina as intermediate between the Caliginæ and the Pandarinæ. This latter is the correct position, as the development proves. The mouth-parts and maxillæ are like those of *Caligus* in early development, but there is no frontal filament, the second antennæ serving in its place. As development progresses the maxillæ become broadened and flattened into laminae (fig. 18) very similar to those of *Pandarus*, while the second antennæ are reduced to normal size and shape. But the female never degenerates into a fixed form like *Pandarus*; on the contrary, the adults of both sexes are fully

FIG. 16.—A CHALIMUS OF ALEBION GLABER JUST READY TO MOLT INTO THE ADULT STAGE, SHOWING THE FOURTH SEGMENT SEPARATED AND THE FOURTH LEGS ALREADY FORMED.

as lively as any *Caligus* and both swim and scuttle about freely. They thus show characters belonging to both the subfamilies mentioned and constitute a well-defined connecting link between them. This is exactly where Gerstaecker has placed them, but there are several reasons why his name of Nogagina can not be accepted for the subfamily.

The first objection is to the name itself. The genus *Nogagus* is made up entirely of males belonging to other genera, *Pandarus*, *Nesippus*, *Demoleus*, *Echthrogaleus*, and *Dinematura*. It has, therefore, no right whatsoever to appear as a separate genus, much less to be taken as the type of a subfamily.



FIG. 17.—THE SECOND ANTENNA OF AN ADULT MALE OF ALEBION GLABER.

There are more species of "*Nogagus*" which are the males of *Pandarus* than of any of the other genera mentioned; hence we should have the anomaly of two subfamilies—one founded on the females and the other on the males—of the same genus.

A second objection is found in the fact that both Gerstaecker and Steenstrup and Lütken are obliged to separate their *Nogagus* males into two groups on generic characters. If this means anything at all it means that we have here two distinct genera under the same name, and this confusion at least ought to be cleared up before the name is used for the type of a subfamily.

Finally, in the subfamily Nogagina, as constituted by Gerstaecker, we find a heterogeneous medley of forms which manifestly do not belong together. As already stated, many *Nogagus* species are the males of *Pandarus*, while others belong to the genera *Nesippus*, *Demoleus*, *Echthrogaleus*, and *Dinematura*. This very resemblance of

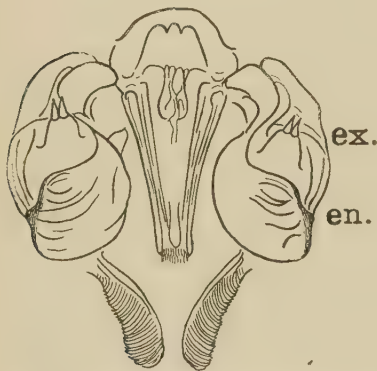


FIG. 18.—THE MOUTH-TUBE AND SECOND MAXILLA OF AN ADULT MALE OF ALEBION GLABER.

the males would suggest strongly that these five genera belong to the same subfamily. Further investigation proves the truth of this suggestion, and they must be classed with the Pandarinæ, as will be clearly shown under that family.

But when you have removed these five genera from Gerstaecker's Nogagina there is not a single species of *Nogagus* left, and hence that name must be dropped. Furthermore, of the genus *Dysgamus*, which Gerstaecker includes in this same subfamily, only the males have been thus

far examined. We can not be sure, therefore, whether this is even a valid genus, and of course can not locate it with certainty (see p. 712). The genus *Trebius*, also included by Gerstaecker in the Nogagina, is classed by most authors with the Caliginæ. We have chosen to place it by itself for reasons stated on p. 670, but wherever it may be placed it clearly does not belong with "*Nogagus*." These eliminations reduce the ten genera which Gerstaecker included in his Nogagina to three, and *Nogagus* is not one of the three.

With these three are to be included Steenstrup and Lütken's *Gloiopotes* and Dana's *Caligeria*, Steenstrup and Lütken's *Dysgamus* (provisionally), and the new genus *Dissonus*, making seven genera in the subfamily. Steenstrup and Lütken<sup>a</sup> have already separated this group very clearly from the rest of the Caliginæ but did not constitute

<sup>a</sup> Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lerneer, 1861, p. 11.



for it a distinct subfamily. That we are now justified in doing, and accordingly the name of the oldest of the five genera, *Euryphorus* (Milne-Edwards, 1840), has been selected for the name of the subfamily, which becomes the Euryphorinæ.

#### SUMMARY.

1. The life history of the genera belonging to this subfamily is similar to that of the Caliginæ except in the following details.

2. The balancers near the posterior end of the nauplius's body are more slender, are cylindrical throughout, and stand out at right angles to the central axis.

3. In the metanauplius the first thorax segment is completely fused with the carapace, a condition as far advanced as that of the chalimus in the Caliginæ. It thus exhibits the first step toward that precocious development which characterizes the more degenerate families of these parasites.

4. The setæ on the terminal joint of the first antennæ in the metanauplius are not plumose, but are very long and dichotomously branched toward their tips, forming a web or mat like that in certain algæ. They thus retain much of the locomotor function which they possessed in the nauplius stage.

5. The second maxillæ in the metanauplius consist of two entirely separate rami of about the same size. The endopod is short and stout and slightly bifurcate at the tip; the exopod consists of two slender diverging spines united at the base.

6. In the chalimus stage there is no frontal filament; instead, the second antennæ are enlarged and extend straight forward in front of the carapace, serving as the only organs of attachment.

7. In the chalimus stage also the second and third segments are fused *inter se*, while the separation of the fourth segment is clearly indicated by a well-marked constriction. This is another evidence of precocious development, for in the following molt, when the fourth segment is fully separated in both subfamilies, we find it without appendages in the Caliginæ, but with a pair in the Euryphorinæ.

8. The second maxillæ in the chalimus are simple, the exopod having thus early degenerated into the form seen in the adult, a papilla fused with the base of the endopod and carrying two small spines.

9. The fourth legs when they first appear are distinctly bifurcate at the tips, the two rami being minute.

10. This life history clearly separates the genera here included from the Caliginæ on the one hand, and, reenforced by the morphology of the adults, from the Pandarinæ on the other. We are thus justified in constituting for them a separate subfamily, intermediate between the two, which is named for the oldest genus included in it, the Euryphorinæ.

## ANALYTICAL KEY TO GENERA.

1. Three thorax segments fused with the head; the fourth segment only free..... 2
1. Only the first thorax segment fused with the head, the others free; no dorsal plates; all the swimming legs biramose, the rami three-jointed.  
*Dissonus* Wilson, 1906, p. 716.
2. One or more pairs of legs uniramose, the others biramose ..... 3
2. All four pairs of swimming legs biramose..... 4
3. First legs only uniramose, their terminal claws curved and simple; setæ on anal laminae short and non-plumose..... *Caligeria* Dana, 1852.
3. First and fourth legs uniramose; claws on first pair straight and three-parted; setæ on anal laminae long and plumose.  
*Gloiopotes* Steenstrup and Lütken, 1861, p. 698.
4. Exopod of fourth legs three-jointed, endopod two-jointed ..... 5
4. Both rami of fourth legs with the same number of joints..... 6
5. Setæ on fourth legs plumose; first abdomen joint much larger than second and covered with a dorsal wing or with two lateral wings.... *Euryphorus* M.-Edwards, 1840.
5. Setæ on fourth legs non-plumose; abdomen joints about the same size, without wings..... *Elytrophora* Gerstaecker, 1853.
6. Rami of fourth legs small, the two joints fused; rami of first three pairs two-jointed, without horny processes ..... *Dysgamus* Steenstrup and Lütken, 1861, p. 712.
6. Fourth legs rudimentary, hidden; exopods of first three pairs with horny processes..... *Aleblion* Kröyer, 1863, p. 702.

## Genus GLOIOPOTES Steenstrup and Lütken.

Carapace large, oval, shield-shaped. Frontal plates wide and distinct, without lunules; first antennæ slender and two-jointed, like those of *Caligus*. Mouth tube short and wide; second maxillæ bifurcate and flattened, but not laminate, as in *Pandarus*. Furca compound. Fourth thorax segment free, with two dorsal plates which cover a portion of the genital segment. First and fourth thoracic legs uniramose, second and third biramose; terminal claws on the first legs three-parted.

Genital segment large, produced backward in the female on either side of the abdomen in the form of an elongated, curved process, carrying a serrated, styliform appendage on its outer border. Genital segment in the male without posterior processes, but having the styliform appendages attached directly to its sides. Abdomen slender and two-jointed; anal laminae elongate and filiform. Egg-cases and eggs as in *Caligus*.

(γλοιός, knavish, and πότης, a drinker or tippler.)

## ANALYTICAL KEY TO THE SPECIES.

1. Dorsal plates on the fourth segment short and rounded, covering only a little of the genital segment ..... 2
1. Dorsal plates elongate, rectangular, covering all the genital segment except the processes..... *hygomianus* Steenstrup and Lütken, 1861.
2. Dorsal plates semilunate, longer than wide; first antennæ concealed; abdomen smooth ..... *huttoni* (Thomson, 1889).
2. Dorsal plates much wider than long; first antennæ prominent; abdomen heavily armed with spines along the sides..... *ornatus* Wilson, 1905, p. 699.

## GLOIOPOTES ORNATUS Wilson.

Plate XVII, figs. 23-34.

*Gloiopotes ornatus* WILSON, 1905, a, p. 127.

*Female*.—Carapace elliptical, about the same length as the rest of the body, considerably longer than wide, strongly arched. Frontal plates well defined, but narrow and without lunules. Posterior sinuses large and well rounded; median lobe less than half the body width, not projecting beyond the lateral lobes, concave posteriorly and somewhat incised at the center.

This lobe enlarges posteriorly until it fills the posterior sinus on either side and overlaps the lateral lobe.

The arrangement of grooves separating the various carapace areas is very complex and constitutes the first important factor in producing the variegated or ornamental appearance of the dorsal surface. Thoracic area large, oblong in general shape, and occupying three-fifths of the width and two-thirds of the length of the carapace. Its lateral grooves have a graceful double curve, while at the center anteriorly is a triangular incision into which fits the posterior end of the eye area. From the apex of this incision a groove extends backward along the median line nearly to the center of the thoracic area, where it divides and sweeps outward toward either side in a broad curve. The thoracic area is thus divided approximately into quarters, each of which is ornamented by various elevations and depressions of the surface.

The eye area is obovate in outline, quite small, and clearly separated from the cerebral area in front, the thoracic area behind, and the lateral areas on either side. The eyes themselves are distinct, situated about in the center of the area, and inclined toward the mid axis. The grooves at the sides of the eye area are prominent and extend forward along either side of the cephalic area of the frontal plates. Numerous smaller grooves branch from those already mentioned and add to the variegated appearance. There is also a row of small spines along either side of the median posterior lobe and a row of long and wavy hairs along the posterior half of the outer margin of the lateral lobes.

The free segment is short and wide and is covered dorsally by two broad plates which extend laterally over most of the basal joints of the fourth legs, and posteriorly over a very little of the genital segment. These plates are smooth and quite transparent along their lateral and posterior margins, but are thrown into numerous folds and wrinkles at the center, where they join each other.

The genital segment is horseshoe-shaped, contracted into a narrow and short neck anteriorly, where it joins the free segment, then widening abruptly to more than half the width of the carapace, and prolonged backward in a stout lobe on either side of the abdomen. The sides of the segment are convex, while the tips of the lobes curve in toward

the abdomen. The dorsal surface of the segment has a few scattered spines on either side at some distance from the mid-line. There is also a row of 5-8 along the center of the lateral margin.

Back of these and at about the centre of the lateral lobes is fastened a triangular flap or membrane, nearly as long as the lobe, quite narrow, and extending diagonally backward and outward.

It is ornamented around its edges with a row of short and stout spines.

The abdomen is cylindrical and two-jointed, the basal joint somewhat wider than the terminal and about half as long.

Near the centre of the terminal joint on the dorsal surface is a large knob, which is ornamented at the sides and above by rows of short spines. The posterior margin of this knob looks like the second joint in the abdomen, but an examination of the ventral surface shows that there is but a single joint.

The anal papillæ are thread-like and about the same length as the terminal joint. They are somewhat broken in all the specimens at command, but did not show any signs of the spines toward their tips, as noticed by Thomson in *Gloiopotes huttoni*. The first antennæ are large, the terminal joint longer than the basal, very narrow, cylindrical, and wholly destitute of setæ. The second antennæ are large and stout, the basal joint considerably flattened and reenforced posteriorly by a short and broad spine, the terminal joint a strong claw with an accessory seta upon its ventral surface.

The first maxillæ are small and three-parted, the two inner prongs shorter and more acute than the outer, which is broad and spatulate. The second maxillæ are short, stout, and bifurcate for more than half their length, the outer branch larger and longer than the inner. These maxillæ are very chitinous and turn dark brown in alcohol, like the tips of the claws and the spines.

The maxillipeds are like those of *Caligus*, the first pair long and slender, the second very large and stout; the basal joint is swollen and nearly twice as long as the slender terminal claw, which latter carries a stout accessory seta on its inner margin.

The furca is compound with bifid branches, between which lies a broad U-shaped sinus; the outer branch extends outward nearly at right angles from the base of the central sinus; the inner branches diverge somewhat; each is enlarged at the tip and subdivided there into two short and blunt knobs. The central foramen has the form of an isosceles triangle, the apex pointing backward.

The swimming legs are very similar to those of *Caligus*; the two inner terminal claws of the first pair are replaced by three-pronged claws, the two ventral prongs being stout, situated side by side, and strongly chitinous, while the dorsal one is slender and remains snowy white even in alcohol (Plate XVII, fig. 31).



The spines on the exopods of the second legs are stout and sharp, and so chitinous that they turn a very deep brown.

The rami of the third legs are close together and each is two-jointed; the endopod is considerably larger than the exopod, unlike the condition in most of the Caligidae, and is closely appressed to the margin of the basal apron. Indeed this ramus is almost exactly like the two terminal joints of the endopod of the second legs. The exopod, on the contrary, is small and short, but has a large bipartite claw or spine on its basal joint. The fourth legs are large and stout, the basal joint much swollen and considerably longer than the three terminal ones, which are only indistinctly separated. The second joint bears a cluster of short spines on its ventral surface near the base, and a longer and stouter spine at the distal end. All three joints carry a fringe of small teeth along their outer margins. Fifth legs entirely wanting.

Total length, 11 mm.; length of carapace, 5.4 mm.; width of same, 4.6 mm.; length of genital segment, 3.4 mm. (including the spiny appendages); length of abdomen, 3.2 mm.

The egg-strings are a little narrower than the base of the abdomen, but broken so that no idea can be given of their length.

Color (of alcoholic specimens) a uniform yellowish gray without pigment; all the chitinous portions were turned a deep russet brown.

(*ornatus*, ornamented, alluding to the numerous spines and grooves on the dorsal surface).

The species described by Thomson in 1889 as *Lepeophtheirus huttoni* and afterwards rightly transferred by Bassett-Smith (1899) to *Gloio-potes* is very similar to the one here described.

The chief differences lie in the dorsal plates which cover the free segment, in the grooving of the dorsal surface of the carapace, in the fringe of long hair adorning the posterior half of the lateral lobes, and in minor details of the appendages, particularly the first antennae and the tripartite first maxillae.

A careful study of the present specimens and their comparison with those described by Thomson suggest forcibly that he did not have a male and female, as he claimed, but rather two females, one with and the other without egg-strings.

The two specimens on which the present species is founded are in the same condition, but they are more nearly alike, and, furthermore, they resemble the one which he designates as a male much more than they do the female. The only sexual differences which he notes consist in a narrowing of the anterior and posterior portions of the body in the female and a diminution in the size of the dorsal plates. Such differences might easily be due to unequal shrinkage, which frequently occurs even with specimens in the same vial, as every investigator who handles preserved material knows only too well.

Furthermore the sexual organs shown in the genital segments of Thomson's "two" sexes are exactly alike, which would be rather an anomaly among the Caligidæ.

The male of *Gloiopotes hygomianus* was described by Stebbing in 1900, and is exactly what would be expected in a genus the females of which show such manifest beginnings of degeneration.

But this male is altogether different from that described by Thomson and adds to the probability that the latter is really an undeveloped female.

This species is founded upon two excellently preserved adult females which were obtained from the outside surface of a swordfish at Woods Hole, Massachusetts. (Cat. No. 6209, U.S.N.M.)

#### Genus ALEBION Kröyer.

The genus *Alebion* was established by Kröyer in 1863 for a single specimen which he claimed was a male and to which he gave the specific name *carchariæ* from its host.

This was sufficiently different from *Caligus* on the one hand and from *Pandarus* on the other to warrant its separation as an intermediate form, and for it Kröyer gave the following diagnosis:

Proboscis intermediate in form between that of the Caliginæ and the Pandarinæ. Palps (second maxillæ) large and stout. Feet of the third (the first thoracic) pair two-branched, the branches biarticulate, the inner one being the smaller. The first, second, and third pairs of thoracic feet armed with corneous bodies of a peculiar form on the laminae of their outer branches. Fourth thoracic legs very rudimentary, uniramous, and two-jointed. Two teeth projecting from the posterior border of the carapace. Sixth thoracic (genital) segment fringed with setæ. Antennal palps, anterior subsidiary hooks (first maxillæ), lunules and furcula lacking.<sup>a</sup>

In 1892 van Beneden described<sup>b</sup> the male and female of a species which he claimed to be the type of a new genus, *Caligera difficilis*. His figures and descriptions are both inaccurate and incomplete, but enough was given to show plainly that he had secured a species of *Alebion*, and it was rightly transferred to that genus by Bassett Smith in 1899.

Bassett-Smith himself found in 1898 what he claimed to be the female of Kröyer's species and gave in the following year these genus characters:

Carapace large, oval. Frontal plates well marked. Anterior antennæ two-jointed. Fourth thoracic segment with small dorsal plates. Genital segment broad, prolonged backward in two elongate processes with the ends and outer margins dentate. Abdomen biarticulate. Caudal plates with long setæ. The first three pairs of thoracic limbs biramous, with lunate corneous bodies on the outer branches; fourth pair of limbs quite rudimentary, hidden.<sup>c</sup>

<sup>a</sup> Bidrag til Kundskab om Snyltekrebsene, 1863, p. 168.

<sup>b</sup> Quelques nouveaux Caligidés de la Côte d'Afrique, et de l'Archipel des Açores, 1892, p. 258. Plate IV. See also p. 367.

<sup>c</sup> A Systematic Description of Parasitic Copepoda found on Fishes, with an Enumeration of the known species, 1899, p. 462.

It is very apparent from an examination of Kröyer's figures and description that his "male" was simply a female without egg-strings, while Bassett-Smith's was a female with egg-strings.

Any attempt, therefore, at sex differentiation between the two is futile. The new species here described with their entire life history, and the true males now for the first time completely differentiated, necessitate many changes in both these generic diagnoses, that of Kröyer being much superior to Bassett-Smith's substitute.

#### GENERIC DIAGNOSIS.

General form similar to that of *Lepeophtheirus*. Carapace elliptical, much longer than the genital segment. Frontal plates well defined and without lunules. Fourth thoracic (free) segment with small but well-defined dorsal plates in the female; these plates very rudimentary or entirely lacking in the male. Abdomen biarticulate. Anal laminae relatively very large and armed with long setae. First three pairs of thoracic legs two-branched, the exopods armed with stout, strongly curved, corneous claws, much larger than those in other genera. Each branch of the first pair biarticulate; of the other two pairs, triarticulate. Fourth legs rudimentary and invisible from the dorsal surface. Furca lacking, but in its place appear two corrugated chitin ridges arranged like the sides of a V, the apex pointing backward (fig. 18, p. 696). Genital segment enlarged as in the Caliginæ, without any traces of fifth legs. Egg-cases and eggs as in *Caligus*, usually quite long. Development similar to that of the Caliginæ, but in the chalimus stage the young are attached by means of their enlarged second antennae, and there is no frontal filament.

#### ANALYTICAL KEY TO SPECIES.

1. Genital segment quadrangular, with rounded corners and without posterior processes ..... 2
1. Genital segment spindle-shaped or lunate, with conical processes at the posterior corners ..... 4
  2. Males; genital segment less than one-third as wide as the carapace; abdomen joints the same width ..... 3
  2. Females; genital segment more than half the width of carapace; basal abdomen joint nearly twice as wide as terminal ..... *glaber* Wilson, 1905, p. 708
3. Genital segment one-fourth longer than abdomen; the two joints of the latter the same length ..... *difficilis* van Beneden, 1892
3. Genital segment one-fourth shorter than abdomen; terminal joint of latter nearly twice as long as basal ..... *gracilis* Wilson, 1905, p. 704
4. Males; posterior processes of genital segment shorter than basal joint of abdomen; fifth legs showing at center of the lateral margins,
 

*glaber* Wilson, 1905, p. 708
4. Females; posterior processes of genital segment as long as, or longer than, the entire abdomen; fifth legs not visible dorsally ..... 5

5. Body of genital segment much wider (1.5 to 3 times) than long, with spines on the margins only..... 6
5. Body of genital segment a little longer than wide, the entire dorsal surface and margins covered with spines; dorsal plates small and close together,  
*difficilis* van Beneden, 1892
6. Dorsal plates small and widely separated; genital segment often entirely smooth..... *gracilis* Wilson, 1905, p. 704
6. Dorsal plates of good size and close together, their bases fused; genital segment and processes with a heavy fringe of spines..... *carchariæ* Kröyer, 1863

#### ALEBION GRACILIS <sup>a</sup> Wilson.

Plate XVIII, figs. 35-48.

*Alebia gracile* WILSON, 1905, p. 128.

*Female*.—Carapace elliptical, a little longer than wide, prolonged anteriorly on the mid line over the frontal plates into a blunt rostrum which just reaches the anterior margin of the frontal plates. Posterior sinuses broad, somewhat enlarged at their bases, and dividing the carapace into nearly even thirds.

Both median and lateral lobes squarely truncated. Grooves separating the areas arranged like the letter H as in *Caligus*, but with the sides widely separated, making the lateral areas narrow and the median area very broad.

Free thoracic segment nearly as wide as the genital segment, half as long as wide, and bearing upon its dorsal surface a pair of semilunar plates. These are parallel to the median line and some little distance from it, their convex sides outward and their posterior ends somewhat enlarged and overlapping the genital segment. This latter is a little more than half the width of the carapace, widest at the center, and prolonged posteriorly on either side into a stout conical spine which reaches beyond the anal laminae. The sides of this segment and its posterior projections carry in the fully developed adult a fringe of short spines while at the tips of the projections are three or four longer ones. In immature females these spines at the tips of the projections are the only ones present.

Abdomen two-jointed, the first joint considerably larger than the second, and extending backward on either side of the latter in a blunt conical projection similar to those on the genital segment. The terminal segment is strongly constricted at its junction with the first and is only about half the width of the latter. It bears at its posterior end a pair of anal laminae nearly as long as the segment itself, slightly enlarged at their tips and curved in toward each other. Each lamina carries four long plumose setae.

First antennae two-jointed as in *Caligus*, but not as heavily armed with spines; posterior pair with a large basal joint and a slender, simple terminal claw attached at one side.

<sup>a</sup> For change in gender see p. 707.



Proboscis slender and conical; the chitin framework is quite simple in construction and consists of four longitudinal plates articulated at the base with the ventral surface of the carapace. They taper rapidly toward the tip, where they are articulated with one another in pairs, two on the ventral and two on the dorsal surface. Between these plates are other shorter ones which only reach half the length of the proboscis.

Over this framework is stretched the upper and under lips. The mouth opening is subterminal and horseshoe-shaped, the curve being at the tip of the proboscis, while the sides extend back on the ventral surface alongside the lower lip. The entire opening is heavily fringed with hairs. The mandibles are slender and somewhat spatulate in shape with a row of ten or twelve comb-like teeth on the inner margin at the tip.

The two pairs of maxillæ are reduced to mere semicircular plates, attached in the normal positions but scarcely raised above the ventral surface. The first and second maxillipeds are normal, the terminal claw on the latter being stout and lacking an accessory spine on its inner margin.

The basal joints of the first pair of legs are rather swollen and carry a short and blunt projection at their outer ends on the ventral surface just where the terminal joints are attached.

The exopod is much larger than the endopod, both being two-jointed; the joints are approximately equal in the exopod and the terminal one carries in addition to the regular plumose setæ and spines a large chitinous claw or process which is curved down tightly against the end of the joint. In the endopod the basal joint is about four times the size of the terminal, the latter being nearly spherical and carrying a single large plumose seta on its inner margin. The second and third legs are normal, save that in each the exopod bears upon the ventral surface of its two terminal joints huge chitin claws similar to those upon the first pair. The rami of the third legs are larger than in *Caligus* and project well beyond the basal lamellæ.

The fourth legs are so rudimentary as to be entirely concealed, in a dorsal view, by the sides of the fourth segment, and in a ventral view by the bases of the third legs. By lifting up the latter the stumps of these legs can be seen on the ventral surface of the free segment; they are papillate, one-jointed, and terminate in three short setæ.

The rudimentary fifth legs can also be seen as triangular stumps near the lateral margins of the genital segment, each carrying three short setæ.

The furca is wanting, but in its place is a pair of chitin ridges, between the bases of the first maxillipeds. These start close together on either side of the mid line and run diagonally forward and outward toward the second maxillæ. They are raised considerably from the

ventral surface and are corrugated like a wood rasp. Egg strings as wide as the last joint of the abdomen and nearly as long as the entire body, each containing from sixty to seventy eggs.

Total length, 10 mm.; length of carapace, 5.35 mm.; width of same, 4.9 mm.; length of genital segment, 3.5 mm.; width of same, 2.66 mm.; length of abdomen, 1.67 mm.; length of egg strings, 9 mm.

Color a transparent cartilage gray, exactly like the skin of its shark hosts.

(*gracilis*, slender, graceful.)

*Male*.—The male differs noticeably from the female in the proportion of the body regions. The carapace is orbicular rather than elliptical, being actually wider than long, while the remainder of the body is strongly narrowed, thus making the contrast between the two very striking. The free thorax segment lacks the plates upon its dorsal surface, but carries on either side a rounded, swollen protuberance, looking like the stump of a large fourth leg which had been amputated. The real rudiments of the fourth legs are borne on the ventral surface of these protuberances and are short and very slender.

The genital segment is small and spindle-shaped and has not even a trace of the posterior conical horns found in the female.

The rudiments of the fifth feet are plainly visible on the ventral surface of this segment.

The abdomen is narrow and made up of two spindle-shaped segments of about the same size, the anal laminae are relatively as large as in the female and each terminates in four plumose setae.

The second antennae are used for clasping organs, and are hence much larger and stronger than in the female, and their terminal claws are branched like a stag's horn. There is also a large claw-like spine projecting from the outer margin of the basal joint near its distal end.

The other appendages are like those of the female, except the second thoracic legs, on the exopods of which, in place of the large claws found in the female, there is a long, conical body protruding from the outer margin of the second joint.

From the peculiar structure of these organs in this and the following species it seems probable that they are connected in some way with the transference of semen to the receptacles in the genital segments of the female.

Total length 6 mm. Length of the carapace 3 mm. Width of same 3.2 mm. Length of genital segment 1.25 mm. Width of same 0.9 mm. Length of abdomen 1.4 mm.

Color the same as that of the female.

*Nauplius*.—Body elliptical, much longer than wide, with evenly rounded ends. Eye spot rather large and of a dark brown color; the other pigment lighter, gathered at the posterior end of the body, and shading anteriorly insensibly into the colorless and transparent region,

which latter fills the whole of the anterior half of the nauplius. The three pairs of appendages attached well forward and of the usual shape. The first pair are not carried pointing directly forward side by side as in the Caliginæ, but extend outward at the sides of the body like the other two pairs. The balancers are widely separated, elongate, cylindrical throughout, very slender, and they taper to an acuminate point.

Total length 0.3 mm. Width 0.165 mm.

This species is fairly abundant and the United States National Museum collection includes ten lots, as follows: From the head of an unnamed shark fourteen females and four males, taken at Clarion Island and numbered 32724, U.S.N.M. (cotypes). From *Mustelus canis* three females (Cat. No. 8122, U.S.N.M.); one female (Cat. No. 12665, U.S.N.M.); one female (Cat. No. 32725, U.S.N.M.). From *Carcharias littoralis* one female (Cat. No. 6205, U.S.N.M.); two females and a male (Cat. No. 32726, U.S.N.M.). From *Carcharias obscurus* three females (Cat. No. 6083, U.S.N.M.). From a pollack a single female (Cat. No. 12664, U.S.N.M.). From a species of *Trygon* a single female (Cat. No. 6210, U.S.N.M.). From a Bonito one female (Cat. No. 32727, U.S.N.M.).

In 1892 (as stated above, p. 702) van Beneden described "a new genus" belonging to this subfamily which he named *Caligera*, with the species *difficilis*. His figures and descriptions plainly show that the copepod was really an *Alebion*, and accordingly Bassett-Smith in 1899 changed the specific name which Beneden had given in order that it might agree in gender with the name *Alebion*.

For he fell into the error of supposing that this name was neuter in gender because it ended in "*on*," and hence he made the new name "*Alebion difficilis*." The present author made the same mistake without looking up the derivation of the generic name. And the two new species published in 1905 were named respectively "*gracile*" and "*glabrum*." But *Alebion* is the name of one of Neptune's sons, hence masculine in gender.

Beneden's description is not very clear, but the points which he emphasizes are sufficient to distinguish his species from the one here described. In *gracilis* the free segment of the adult female is three-fourths as wide as the genital segment, while its dorsal plates are widely separated even at their bases.

In *difficilis* the free segment is only a little more than half the width of the genital segment and its dorsal plates are close together with their bases fused. But the greatest differences appear in the genital segment; in *difficilis* the body of this segment is longer than wide, while the posterior processes are slender, cylindrical, and parallel. Moreover the entire dorsal and ventral surfaces as well as the margins are covered with a thick coating of spines. But in *gracilis* the body of

the genital segment is one-half wider than long, and its posterior processes are stout, conical, and considerably divergent.

In this species also there are never more than a few scattered spines along the margins of the segment and on its processes, while in many specimens the entire segment is without spines.

There are also numerous minor differences in the detail of the appendages, particularly the mouth parts and the third thorax legs. In the males the chief differences lie in the relative size and shape of the genital segment and abdomen as already brought out in the key on p. 703.

From Kröyer's species, *carchariæ*, the present form differs in the size and position of the dorsal plates on the free segment, in the size and shape of the genital segment, and in the detail of the appendages. In the female described by Kröyer the dorsal plates on the free segment were close together, their bases fused, with an angular intervening space, and they reached back to the center of the body of the genital segment.

Bassett-Smith says of the female which he described: "In outward form the dorsal plate covering the last thoracic segment was much less apparent."<sup>a</sup> There must have been two of these plates, and the fact that he speaks of them as one would indicate thorough fusion. Here, on the contrary, we find the dorsal plates noticeably distinct to their very bases which are widely separated, while they scarcely overlap the genital segment at all, to say nothing of reaching its center.

Again the female described by Kröyer had a genital segment more than three-fifths as wide as the carapace, and the body of it, exclusive of the processes, is nearly twice as wide as long. In the female described by Bassett-Smith the genital segment was two-thirds the width of the carapace and more than three times as wide as long. But in the present species the genital segment even of a female carrying egg-strings is not half the width of the carapace, and is less than one-third wider than long.

Here again also the genital segment is smooth or has but few setæ, while in *carchariæ* there is a heavy fringe around the entire margin and along the processes.

**ALEBION GLABER** <sup>b</sup> Wilson.

Plate XIX, figs. 49-61; figs. 17 and 18, pp. 695 and 696.

*Alebion glabrum* WILSON, 1905, p. 129.

*Female*.—Carapace orbicular, squarely truncated posteriorly. Frontal plates well defined. Posterior sinuses broad and deeper than in *gracile*. Longitudinal grooves between the carapace areas widely separated leaving a very broad median area.

<sup>a</sup>Some new or rare Parasitic Copepods found on Fish in the Indo-tropic Region, 1898, p. 367.

<sup>b</sup>For the change in gender, see p. 707.



Free thorax segment nearly as wide as the genital segment, two-fifths as long as wide. Dorsal plates rather small and nearly orbicular, separated by a wide median space.

Genital segment half the width of the carapace, oblong in shape, with nearly parallel sides and well-rounded angles. Its entire margin is smooth and without any trace of the marginal fringe of spines or the posterior prolongations on either side of the abdomen which are present in other species.

Abdomen two-jointed, the joints about the same size; on either side of the first joint a semicircular wing or thin fold of skin projects outward laterally from the dorsal surface, the combined width of the joint and the two wings being about half that of the genital segment. The first abdomen segment has a convex anterior and a concave posterior margin. The terminal segment is slightly spindle-shaped, with comparatively small and elliptical anal laminae. The plumose setae on these laminae are smaller than in other species. The egg-strings are wide and about once and a half the length of the body.

Anterior antennae two-jointed, with the terminal joint much smaller than the basal and strongly club-shaped.

The posterior antennae have a large basal joint with a stout and well-curved terminal claw.

First maxillipeds the same as in all the Caliginæ; second pair large and stout, the terminal claw strong, but not much curved.

On the inner margin of this claw near its tip is a small, flattened flange which extends about a third of the length of the claw. The two pairs of maxillae are similar to those of *gracilis*, but the first pair are even more rudimentary and can be found only with difficulty. The ventral ridges between the bases of the maxillipeds, which take the place of the furca, are similar to those in *gracilis*, but are considerably larger with deeper corrugations.

The basipod of the first pair of legs is rather small, the exopod almost exactly like that of *gracilis* in size, shape, and armature, but the endopod is quite different. Its proximal joint is long with a very wide flange on the inner margin; attached to this flange where it joins the basipod is a small strawberry-shaped papilla. The terminal joint of the endopod carries three setae of equal size as in *carchariæ*.

The second legs resemble those of *gracilis* very closely in segmentation and armature, but the joints are relatively smaller.

The third legs present several differences; the exopod is narrow and nearly as long as the endopod; its segments are much longer than wide, thus separating the large claws with which each segment is armed. The endopod is short and stocky and shows its segmentation distinctly. The fourth legs are similar to those of the other species of the genus.

but the fifth legs show a distinct exopod and endopod instead of a single triangular stump, which is exceptional in females.

Total length, 12 mm. Length of carapace, 5.9 mm. Width of same, 6 mm. Length of genital segment, 3.1 mm. Width of same, 3 mm. Length of abdomen, 2.5 mm. Length of egg-strings, 15 mm. Of a grayish horn color, nearly uniform throughout, and not quite as transparent as *gracilis*.

(*glaber*, smooth.)

*Male*.—Carapace distinctly longer than wide and obovate or acorn-shaped, with the widest portion very far back. Posterior sinuses triangular and flaring widely. Free thorax segment long and narrow, less than half the width of the genital segment; dorsal plates so rudimentary as to be indistinguishable.

Genital segment narrow, spindle-shaped, squarely truncated posteriorly, with a conical papilla projecting outward and backward from each corner and terminating in three small spines.

These are the rudiments of the sixth legs, those of the fifth pair appearing at about the center of each side of this genital segment and showing a distinct exopod and endopod.

The abdomen is made up of two nearly equal segments, without the wings, which appear in the female. The anal laminae and their setae are relatively much larger than those in the female.

The second antennae are branched like those in the male of *gracilis*; the other appendages are the same as in the female, except the second legs. Here in place of the large claws upon the exopod we find a pair of curious structures upon the outer distal margin of the second exopod joint. The outer of these is much the larger, conical in shape, nearly as large as the joint itself, and covered with small spherical warts or papillae. The smaller inner one is narrow, cylindrical in form, and two-jointed, the basal joint being four times as long as the terminal, with no peculiarities visible.

Total length, 7.6 mm.; length of carapace, 3.5 mm.; width of same, 3.1 mm.; length of genital segment, 1.25 mm.; width of same, 1.1 mm.; length of abdomen, 1.35 mm.

Color similar to that of the female.

*Metanauplius* (figs. 4-9).—One thorax segment fused with the head to form the carapace, which is spindle-shaped, the two ends about the same size and both emarginate (fig. 4). Eyes very large and situated just in front of the center of the carapace on the mid-line.

Frontal plates distinct, but widely separated and folded over on the ventral surface. Second thorax (first free) segment wider than the rest of the thorax and abdomen, its sides strongly convex. Third segment about the same length as the second, but narrower and its sides not as convex, though still well curved. Fourth and genital segments united with the abdomen into a segment only one-fourth longer than the third segment, with concave sides and well-rounded corners.

Anal laminae short and wide, each bearing four large and one small plumose setae.

First antennae two-jointed, the second joint terminating in very long nonplumose setae, which are dichotomously branched toward their tips. Second antennae much enlarged and curved over ventrally in a half circle. They are the chief organs of prehension and are carried straight forward side by side in front of the carapace.

Second maxillae with distinct endopod and exopod, both of which are bifurcate at their tips. First and second maxillipeds two-jointed and extending well beyond the lateral margins of the carapace. Two pairs of swimming legs, each biramose, the rami one-jointed.

Total length, including second antennae, 1.15 mm.; length of carapace, 0.65 mm.; width of same, 0.32 mm.; width of free segments, 0.15 mm.

Color as in the adult, with pigment spots only along the posterior margin of the carapace and on the abdomen.

*Chalimus* (figs. 10–15).—One thorax segment united with the head to form the carapace, which is elliptical, about one-half longer than wide, the posterior border emarginate. Frontal plates well defined and projecting on either side over the basal joints of the first antennae. Eyes farther forward than in the metanauplius, but still very large. Second and third segments fused *inter se*, the former much wider than the latter.

Fourth and genital segments still fused with the abdomen, but much longer than in the metanauplius and showing a deep constriction on either side. Appendages as before, but each first antenna is now tipped with five short and simple setae; the exopods of the second maxillae are now reduced to papillae on the bases of the endopods, and there are three pairs of swimming legs all biramose and the rami one-jointed.

Total length 2 mm., length of carapace 1 mm.; width of the same 0.7 mm.; width of first free segment 0.55 mm.; of the second, 0.35 mm.

Pigment spots now distributed along the entire length of the lateral margins. Otherwise colored like metanauplius.

This is a large and clean-looking species and must be fairly common since the United States National Museum collection contains the following lots of specimens: From the smooth dog-fish, *Mustelus canis* (Cat. No. 8123, U.S.N.M.), consisting of twelve females and six males, taken as the types; (Cat. No. 32830, U.S.N.M.), a single male; (Cat. No. 32831, U.S.N.M.), three females; (Cat. No. 32832, U.S.N.M.), eight females; 6204, one female from Long Island Sound; 32833, one female; (Cat. Nos. 32834 and 32835, U.S.N.M.), development stages, ten specimens each; (Cat. No. 32836, U.S.N.M.), two females; (Cat. No. 32837, U.S.N.M.), five females. From *Squalus acanthias*, three females, two males; from sand shark, *Eugompodus littoralis*, three females, both by V. N. Edwards, the former 32838, the latter 6102. From barn-

door skate (Cat. No. 32839, U.S.N.M.), eight females; from bonito (Cat. No. 32840, U.S.N.M.), one female.

This species presents a marked contrast to all the other species thus far known in the entire absence of posterior processes on the genital segment of the female. This segment has instead well rounded posterior corners, and there is not a vestige left of the fringe of spines that adorns the margin in other species. In this respect, therefore, the four species form a well-defined series, beginning with *difficilis*, in which the entire genital segment is covered, passing through *carchariae*, in which there is a heavy fringe along the margins, *gracilis*, in which there are only scattered spines here and there, and ending with *glaber*, in which the spines have entirely disappeared.

There is also a direct antithesis in the relative structure of the genital segment in the two sexes between this species and *gracilis*. In the present species the female has no posterior processes, while the male possesses a pair, although in a considerably reduced form. In *gracilis*, on the contrary, the female has a pair of stout posterior processes, while the male wholly lacks them.

#### Genus DYSGAMUS Steenstrup and Lütken.

(Founded on males only.)

*Generic diagnosis*.—First three thorax segments united with the head to form a large rounded carapace. Frontal plates distinct and prominent; eyes large and in contact with each other on the mid-line. Fourth thorax segment free and without dorsal plates. Genital segment small and evenly rounded, without posterior lobes or rudimentary legs. Abdomen short, two-jointed, with small anal laminae. First antennae two-jointed, joints equal in length; second pair as in *Alecion*. Mouth-tube narrow and conical, longer than in *Euryphorus*, not as long as in *Alecion*. Second maxillae simple, broadly triangular, and slightly curved at the tips; maxillipeds as in *Euryphorus*. All four pairs of legs biramose, the rami two-jointed.

(*dysgamus*, δύς, badly, and γάμος, wedded, alluding to the fact that no females were found.)

This genus was founded in 1861 by Steenstrup and Lütken upon ten or more male specimens captured at several different places in the Atlantic north of the equator. These males were about the same size (3.5 mm. long), and agreed fully in all essential characters. Bassett-Smith, the only other writer who has mentioned the genus, stated in 1899 that—

This genus was made by Steenstrup and Lütken from a male only; but in the collection of the British Museum there are a large number of specimens, some with external ovaries attached, which I have examined and have no doubt of their identity; therefore the genus is allowed to stand. <sup>a</sup>

<sup>a</sup> A systematic Description of Parasitic Copepoda found on Fishes, with an Enumeration of the known Species, 1899, p. 460.



And on the next page he adds: "Host: 'Shark,' Atlantic and Indian oceans."

This last must have been taken from the labels of the British Museum specimens, for Steenstrup and Lütken distinctly state that their specimens were taken "probably while swimming freely at the surface."<sup>a</sup>

If Bassett-Smith's observation regarding the "large number of specimens, some with external ovaries attached," in the British Museum be correct, there is a probability that the genus is valid. But we can not be certain until the females are described; for the present, therefore, both the original species and the new one here described are to be accepted provisionally.

**DYSGAMUS ARIOMMUS, new species.**

Plate XX, figs. 62-70.

*Male*.—Carapace 0.6 of the entire length, ovate, considerably widened and squarely truncated posteriorly. Frontal plates prominent and distinct, without lunules, but with a broad and shallow incision at the center. Cephalic area divided by a transverse groove which starts from the lateral groove on either side at a point opposite the eyes, and then divides, one-half passing in front of the eyes and the other half behind them, in the form of two semicircles of different diameters, the posterior one being the smaller. Thoracic area three-fifths of the width of the carapace, but short, with nearly straight and parallel sides; squarely truncated both anteriorly and posteriorly.

Lateral areas narrow and elongate, showing clearly the separation between the head and first thorax segment; posterior lobes, with bluntly-rounded ends just reaching the posterior margin of the thoracic area. The narrow and tapering lateral lobes which extend from the sides of the second segment backward inside of, and parallel to, the carapace lobes are not as completely fused with the latter as usual, but are separated from them by very narrow and slit-like incisions, which extend inward halfway to the anterior margin of the second segment. The tips of these second segment lobes do not quite reach the posterior margin of the third segment, which is considerably narrower than the second.

The lateral lobes of the third segment are broadly triangular and extend diagonally outward and backward over the bases of the third legs. The fourth segment is narrower than the third with prominent and well-rounded sides. Genital segment 0.175 of the entire length, of a plump, barrel shape, with squarely truncated ends; no rudimentary legs visible.

<sup>a</sup> Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernaer, 1861, p. 368.

Abdomen two-jointed; joints about the same length, the basal one slightly the wider with tapering sides; anal laminae nearly circular in outline, each armed with four long, stout, and densely plumose setae. Anterior antennae two-jointed, joints about the same length, both setiferous; posterior pair rather small, with a stout terminal hook and a curved spine on the posterior margin of the basal joint. No first maxillae; second pair simple flattened spines, broadly triangular, situated at some distance from the mouth-tube on either side, and very far back, nearly opposite the mouth opening.

Mouth-tube narrow and conical, intermediate in form, longer and narrower than in *Gloiopotes* and *Euryphorus*, but not as elongate and pointed as in *Alcobion*. Mouth opening terminal and circular, surrounded with a heavy fringe of hairs. First maxillipeds of the usual pattern; second pair enlarged, the basal joint much swollen, but showing no sign of any protuberance or peg opposite the terminal claw. This latter is slender, strongly curved, and reaches about to the center of the basal joint. All the swimming legs are biramose, rami of the first three pairs two-jointed, of the fourth pair rudimentary and apparently one-jointed, owing to a more or less complete fusion of the joints. Exopod of the first pair several times larger than the endopod, with three huge plumose setae on its posterior border, which are longer than the entire leg.

There are also three good-sized terminal setae and a large spine at the outer corner. The terminal joint of the tiny endopod has also three plumose setae on its posterior border and three spines at the end, while the basal joint carries a single spine on its anterior margin. There is also a large plumose seta on the outer margin of the basal joint of the leg itself, which projects out over the ventral surface of the exopod. Second legs of the usual pattern. Rami of the third legs so near together that their basal joints overlap considerably. Joints of the rami in the fourth legs so fully fused that they appear to be one-jointed, but the arrangement of the setae shows that there are really two joints in each ramus. Fifth legs entirely lacking.

Total length, 3.5 mm.; length of carapace, 2 mm.; of genital segment, 0.57 mm.; of abdomen, 0.43 mm.; width of carapace, 1.92 mm. Color of preserved material yellowish brown, somewhat mottled, and without any visible pigment.

(*arionimus*, ἀρί, an intensive particle; ὄμμα, eye; hence large-eyed.)

That the present species is distinct from Steenstrup and Lütken's *D. atlanticus* is apparent from the following considerations: The grooves on the dorsal surface of the carapace are arranged very differently, particularly around the eyes. Steenstrup and Lütken make no mention of any eyes either in their description or figures, while in the present species they are large and prominent.

In *atlanticus* the carapace is relatively larger, being nearly six times the width of the free and genital segments; here it is only three times the width of the genital segment and much less than that compared with the free segment.

Furthermore in *atlanticus* the thoracic area is relatively narrow and evenly rounded posteriorly, while here it is much wider and squarely truncated.

In *atlanticus* also the free segment is the same width as the genital segment, while the terminal joint of the abdomen is several times larger than the basal. In the present species the free segment projects considerably over the bases of the fourth legs, and the abdomen joints are of the same size.

Specific differences may also be noted in the structure of the second antennæ, the second maxillipeds, the furca, and the four pairs of swimming legs, particularly the fourth pair, which are small and somewhat rudimentary in the present species.

Here also these fourth legs are connected across the mid-line like the three preceding pairs. Whether the same condition obtains in *atlanticus* is not stated, but it furnishes a characteristic which is quite distinct from other closely allied genera.

Although there is but a single specimen of this species it is well differentiated and proves to be of considerable morphological importance, for it helps to settle the exact relation of the different carapace areas in these three subfamilies, the Caliginæ, the Trebinæ, and the Euryphorinæ. In them, two, and usually three, of the anterior thorax segments are fused with the head, and there has been considerable

discussion by various authors as to the morphological significance of the different portions of the carapace. A careful study of the carapace of the present species, compared with that of the three species of *Trebius* already described, and also with that of a mature chalimus of *Lepeophtheirus nordmannii*, recently obtained by the author from the United States Bureau of Fisheries, leaves little chance for further doubt. It will be seen in fig. 19 that the carapace of the present species is divided transversely by three grooves. The anterior of these (a) separates the frontal plates from the carapace;

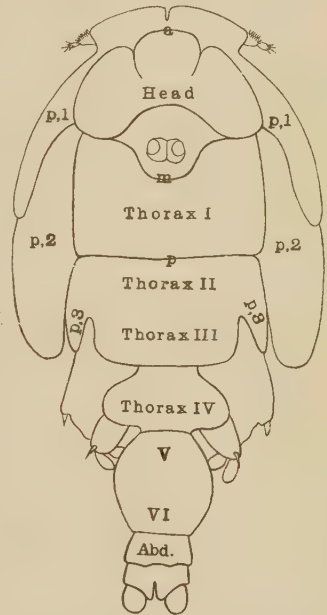


FIG. 19.—THE DORSAL SURFACE OF A MALE DYSGAMUS ARIOMMUS, SHOWING AREAS AND SEGMENTS. a, ANTERIOR; m, MEDIAN, AND p, POSTERIOR TRANSVERSE GROOVES. p, 1, p, 2, AND p, 3, LATERAL LOBES OF THE HEAD, FIRST AND SECOND THORAX SEGMENTS RESPECTIVELY.

the middle one (*m*) is the dividing line between the head and the first thorax segment, while the posterior one (*p*) separates the first from the second thorax segments. There is no visible groove here between the second and third thorax segments, but in *Trebis* (Plate XV, figs. 1 and 2) we find that it joins the posterior sinuses of the carapace and is approximately parallel with the other transverse grooves.

The middle groove is extended outward and backward across the lateral area on either side to the edge of the carapace, where it makes a notch similar to that left by the corresponding groove in *Trebis*. In the three species of this latter genus it can be seen that the portion of the lateral grooves which lies behind the crossbar of the "H" is really a part of that crossbar groove in that it completes the separation of the second thorax segment from the first. We are thus enabled to see distinctly that the anterior and outer portion of the lateral areas (*P. 1*) is really a sort of lateral lobe or process belonging to the head. The remainder of the lateral areas is similarly seen to be a process or lobe (*P. 2*) of the first thorax segment. In like manner that portion of each posterior lobe of the carapace which is inside of the longitudinal groove (*P. 3*) represents a lateral process or lobe of the second thorax segment. Neither the third nor the fourth thorax segments have any lateral processes.

Like the original specimens of *atlanticus* the single representative of this species was taken while swimming freely at the surface during the voyage of the United States Bureau of Fisheries steamer *Albatross* in 1887-88. It is Cat. No. 32728, U.S.N.M. This genus *Dysgamus* was placed by the author among the Caliginæ in a key given in a previous paper.<sup>a</sup> That, however, was before the present specimen had been obtained and studied. The genus evidently belongs with the Euryphorinæ where it was placed by Gerstaecker, as is shown by the description and figures here given, but we must have a description of the female before this matter can be finally settled.

#### Genus DISSONUS Wilson.

*Generic diagnosis.*—Only the first thorax segment fused with the head to form a carapace, which is semilunar in shape and about twice as wide as long. Second, third, and fourth segments free, each considerably wider than long, the second one only provided with lateral plates. Genital segment not much enlarged, without plates or processes, but with the entire ventral surface sparsely covered with spines. Abdomen small, nearly as wide as long; anal laminae of medium size and armed with large plumose setae. Egg-strings four-fifths the entire length; eggs large, about 40 in each string. Antennae and mouth-parts similar to those in the Caliginæ and not at all like those in the

<sup>a</sup> Proc. U. S. Nat. Mus., XXVIII, 1905, p. 533.



Pandarinae. Second maxillae bifurcate at the tip; first maxillae and furca wanting. All four pairs of swimming legs biramose; rami of the first pair two-jointed, of the other pairs three-jointed; jointing, spines, and setae almost exactly like those in *Trebius*.

(*dissonus*, disagreeing or different; i. e., a connecting link which does not agree with any of the established subfamilies.)

#### DISSONUS SPINIFER Wilson

Plate XX, figs. 71-72.

*Dissonus spinifer* WILSON, 1906, p. 198, pl. III, figs. 34-47.

*Female*.—Carapace transversely semilunar, twice as wide as long; dorsal surface with but a single pair of grooves, separating the lateral areas from the cephalic. Eyes moderately large, close to the anterior margin; in contact with each other on the mid-line, but not fused. A pair of elliptical spots in front of the eyes raised like lenses. Second, third, and fourth segments diminishing regularly in size; second segment as wide as the carapace and its lateral plates as wide as the lateral lobes of the carapace. Third and fourth segments considerably narrowed, but even the fourth twice as wide as long. Genital segment quadrangular, a little wider than long and a little narrower than the fourth segment; posterior processes small, fifth legs invisible dorsally. Abdomen three-eighths the length of the genital segment, one-fourth wider than long, with a shallow anal fissure. Anal laminae quadrangular, each with four large plumose setae, three of which are terminal, while the other comes out of the lateral margin near the anterior end.

The two pairs of antennae like those of *Caligus*; first maxillae and furca entirely lacking; mandibles slender, three-jointed, toothed on the inner margin near the tip.

Mouth-tube triangular with a narrow tip; mouth-opening terminal and heavily fringed with hairs. Second maxillae large and powerful, reaching well beyond the tip of the mouth-tube; basal portion enlarged and flattened, bearing the rudimentary exopod; endopod triangular and curved, bifurcate at the tip, the outer branch a little the larger and longer. The two pairs of maxillipeds of the usual pattern, the basal joint of the second pair with a stout corrugated knob against which shuts the tip of the terminal claw. In the first pair of swimming legs the exopod is a little more than twice the length of the endopod, and its basal joint is three times as long as the terminal. The endopod joints are about the same size. The other swimming legs as in the Trebinae and other Euryphorinae, the fifth pair as small papillae, each armed with three setae.

Cement glands small, broadly club-shaped, and reaching but little in front of the center of the genital segment.

Total length, 3 mm.; length of carapace, 0.85 mm.; of free thorax, 1.1 mm.; of genital segment, 0.71 mm.; of abdomen, 0.34 mm.; of egg-strings, 2.35 mm.; width of carapace, 1.75 mm.

*Male*.—Similar to the female in general appearance and in most of the details of structure. Genital segment elongate spindle-shaped, one-third longer than wide, with evenly rounded sides; anterior margin reentrant, posterior one nearly squarely truncated.

Both the fifth and sixth legs visible, the former on the lateral margins, the latter at the posterior corners. Abdomen not as wide as in the female, and the anal laminae a little smaller.

Second antennae especially large and stout, the terminal claw bearing on its inner margin a long curved spine, a short blunt one, and a long slender hair. Second maxillae larger and more powerful than in the female, the outer branch at the tip nearly twice as long as the inner one. Spines on the ventral surface of the genital segment larger and more numerous than in the female.

Total length, 3 mm. Length of carapace, 0.8 mm.; of free segments, 1.08 mm.; of genital segment, 0.8 mm.; width of carapace, 1.9 mm.

Color of the two sexes (preserved material) the same, a uniform yellowish white without pigment.

(*spinifer*, *spina*, a spine; and *fero*, I bear).

Through the courtesy of Prof. W. A. Herdman, of the University of Liverpool, the collection of the United States National Museum contains a specimen of each sex of this new genus, Cat. No. 32729, U.S.N.M.

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## EXPLANATION OF THE PLATES.

PLATE XV.—*Trebius exilis* Wilson, and *T. tenuifurcatus* Rathbun.

- Fig. 1. *Trebius exilis*, dorsal view of female.  
 2. Dorsal view of male.  
 3. Second antenna and first maxilla of female.  
 4. Second antenna of male.  
 5. Mouth tube and second maxilla.  
 6. Furca.  
 7. Fourth swimming leg.  
 8. *Trebius tenuifurcatus*, dorsal view of female.  
 9. Second antenna and first maxilla.  
 10. Furca.  
 11. Second antenna and first maxilla of *Trebius caudatus* Kröyer.  
 12. Mouth tube and second maxilla of same.  
 13. Furca.

PLATE XVI.—*Trebius caudatus* Kröyer.

- Fig. 14. Dorsal view of female.  
 15. Dorsal view of male.  
 16. First maxilliped.  
 17. Second maxilliped.  
 18-21. First, second, third, and fourth swimming legs.  
 22. Ventral view of genital segment of female.

PLATE XVII.—*Gloiopotes ornatus* Wilson.

- Fig. 23. Dorsal view of female.  
24. Second antenna.  
25. First maxilla.  
26. Second maxilla.  
27. First maxilliped.  
28. Second maxilliped.  
29. Furca.  
30-34. First, second, third, and fourth swimming legs.  
31. Three-parted spine on the first leg, magnified.

PLATE XVIII.—*Alebion gracilis* Wilson.

- Fig. 35. Dorsal view of female.  
36. Dorsal view of male.  
37. Second antenna of female.  
38. Second antenna of male.  
39. Second antennæ, mouth tube, and second maxillæ of female, showing relation of the parts.  
40. Dorsal view of mouth tube, enlarged.  
41. Ventral view of tip of same, showing opening.  
42. Mandible.  
43. First maxilliped.  
44. Second maxilliped.  
45-47. First, second, and third swimming legs.  
48. Ventral view of genital segment of female.

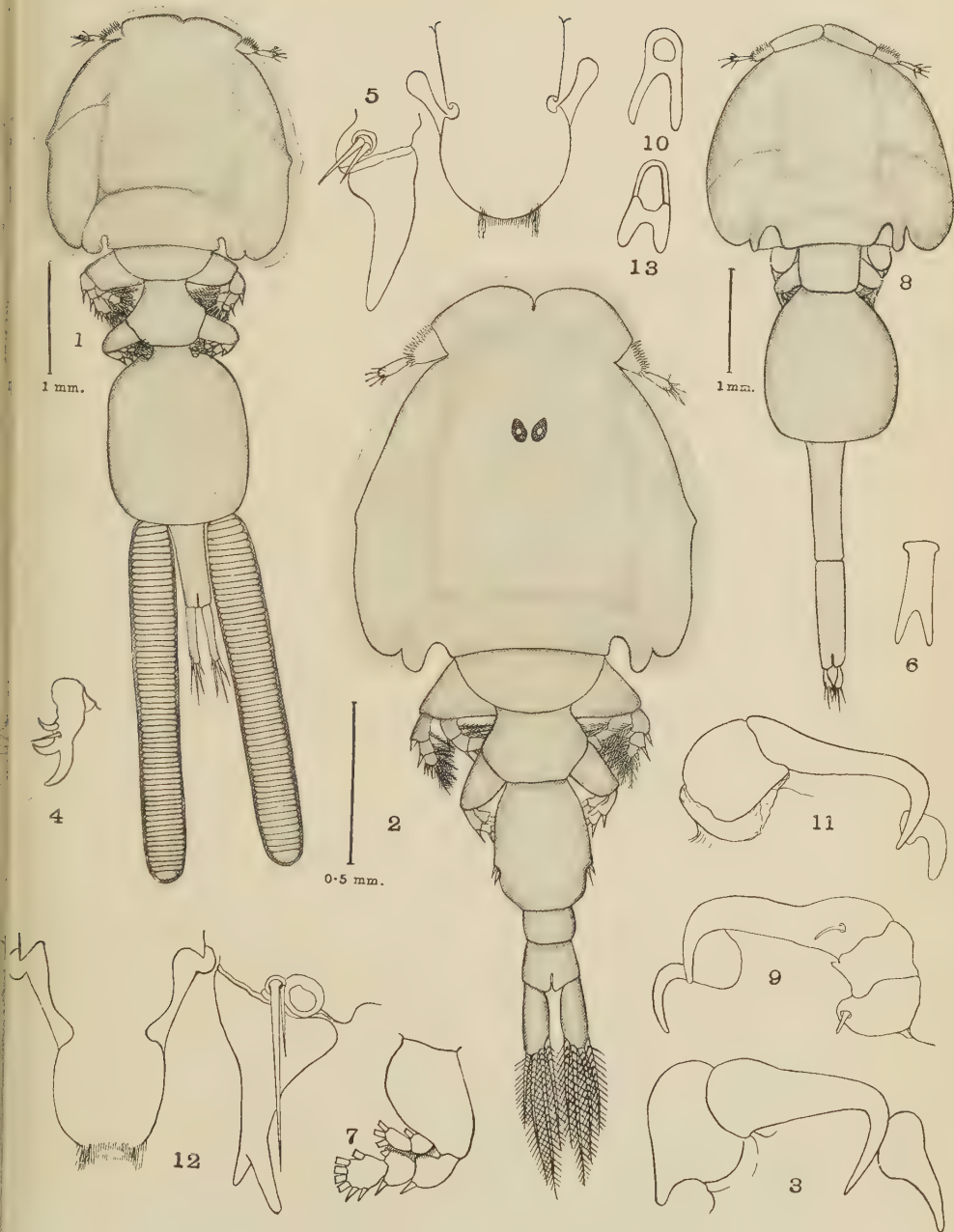
PLATE XIX.—*Alebion glaber* Wilson.

- Fig. 49. Dorsal view of male.  
50. Dorsal view of female.  
51. Second antenna of female.  
52. Mouth tube, second maxillæ, and chitin pads.  
53. First maxilliped.  
54. Second maxilliped.  
55-58. First, second, third, and fourth swimming legs.  
59. Rudimentary fifth legs, greatly enlarged.  
60. Ventral view of genital segment of female with spermatophores in place.  
61. Ventral surface of genital segment of male, showing rudiments of both fifth and sixth swimming legs, and a partial separation of the sixth thorax segment.

PLATE XX.—*Dysgamus oriomus*, new species; and *Dissonus spinifer* Wilson.

- Fig. 62. Dorsal view of male of *Dysgamus oriomus*.  
63. Second antenna.  
64. Mouth tube and second maxillæ.  
65. Second maxilliped.  
66. Furca.  
67-70. First, second, third, and fourth swimming legs.  
71. Dorsal view of female of *Dissonus spinifer*.  
72. Dorsal view of male.

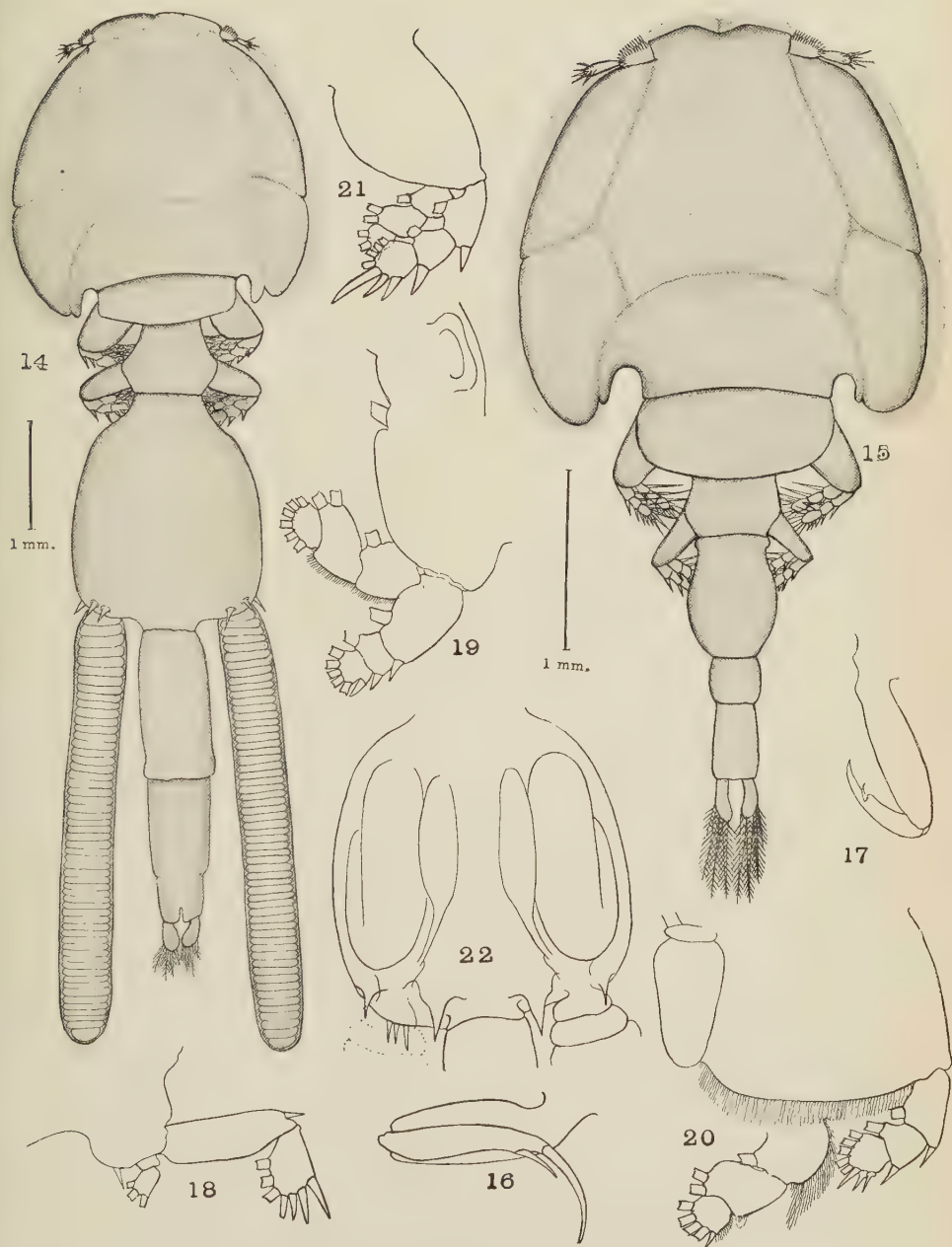




THE MALE AND FEMALE OF *TREBIUS EXILIS*, AND THE FEMALE OF *TREBIUS TENUIFURCATUS*.

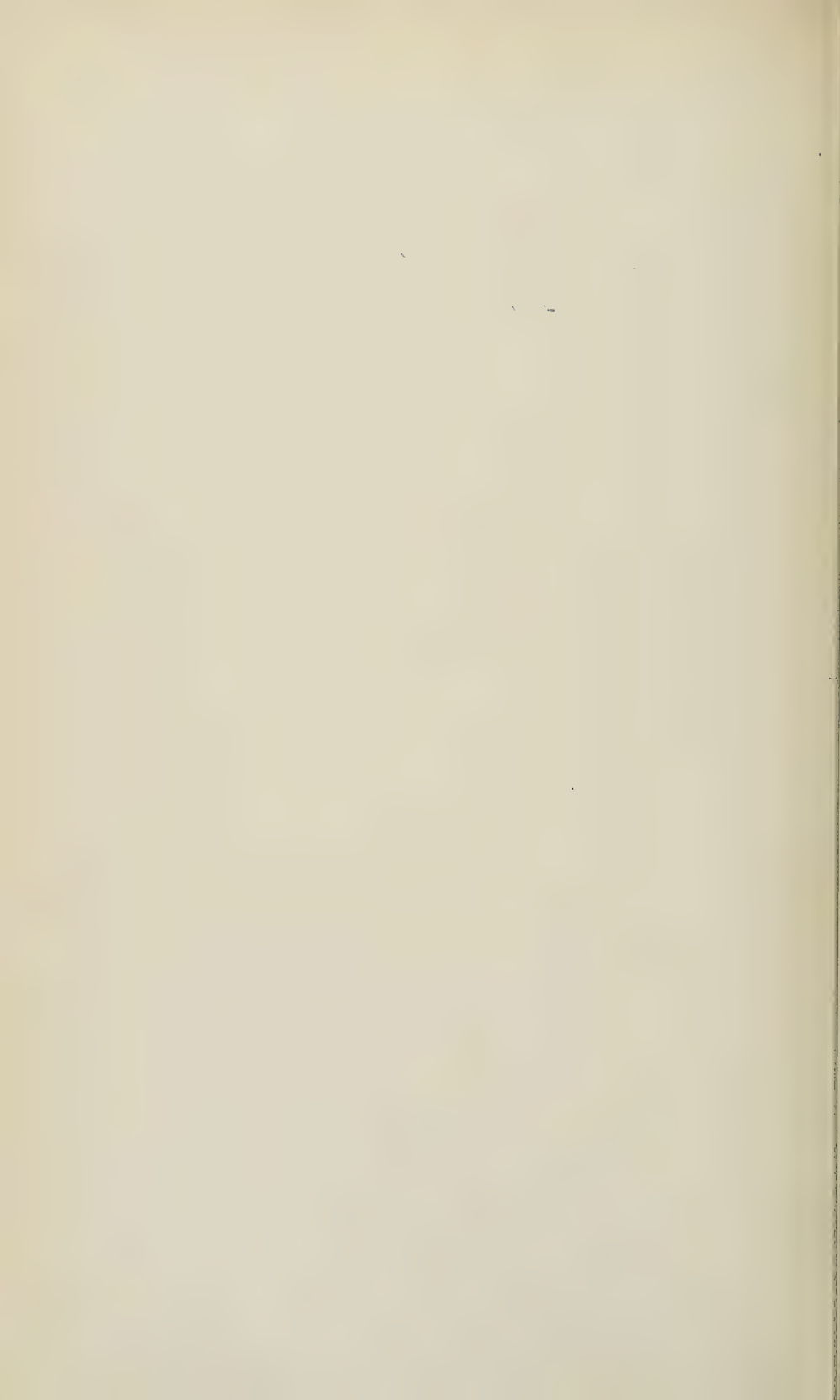
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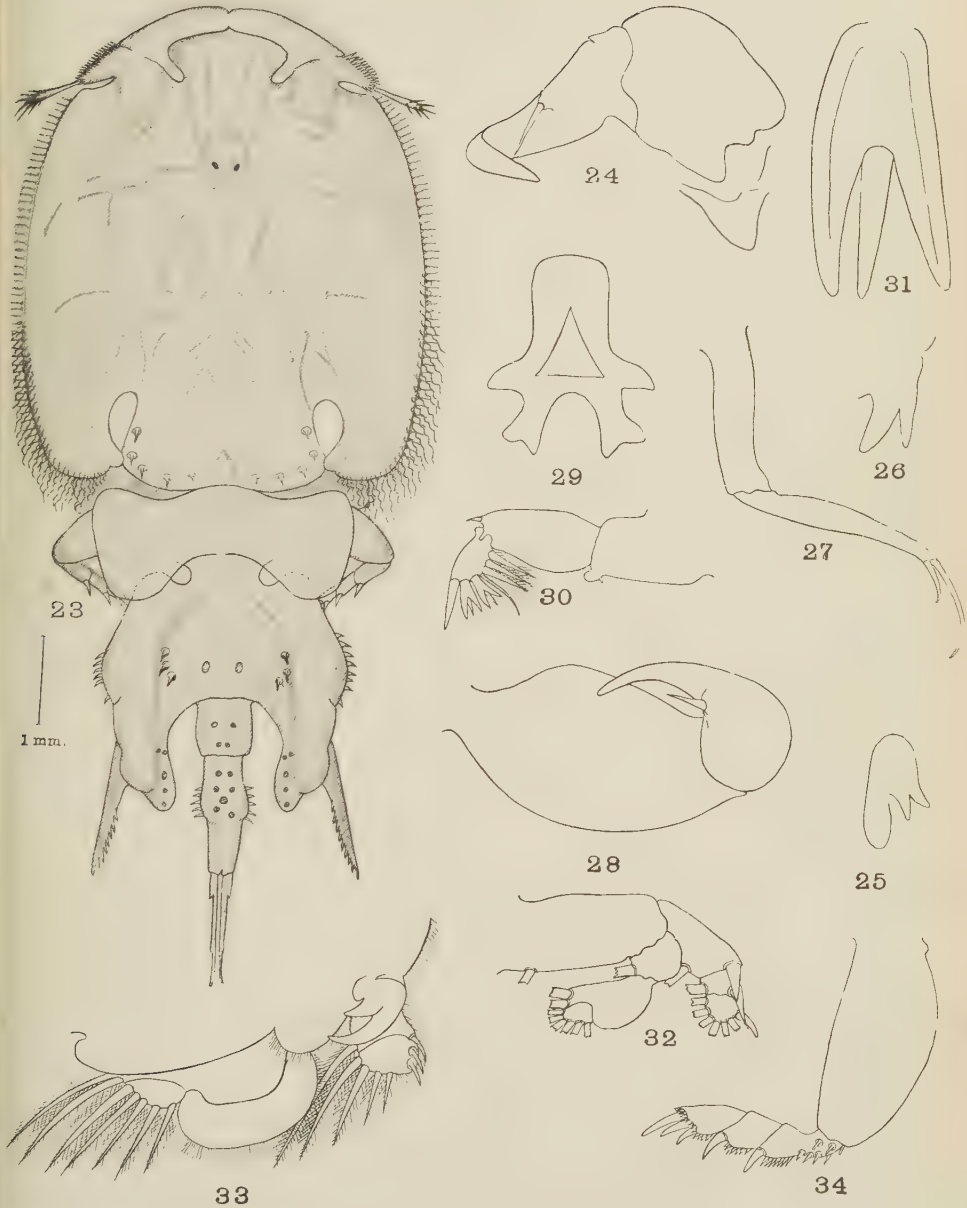


THE MALE AND FEMALE OF *TREBIUS CAUDATUS*.

FOR EXPLANATION OF PLATE SEE PAGE 719.



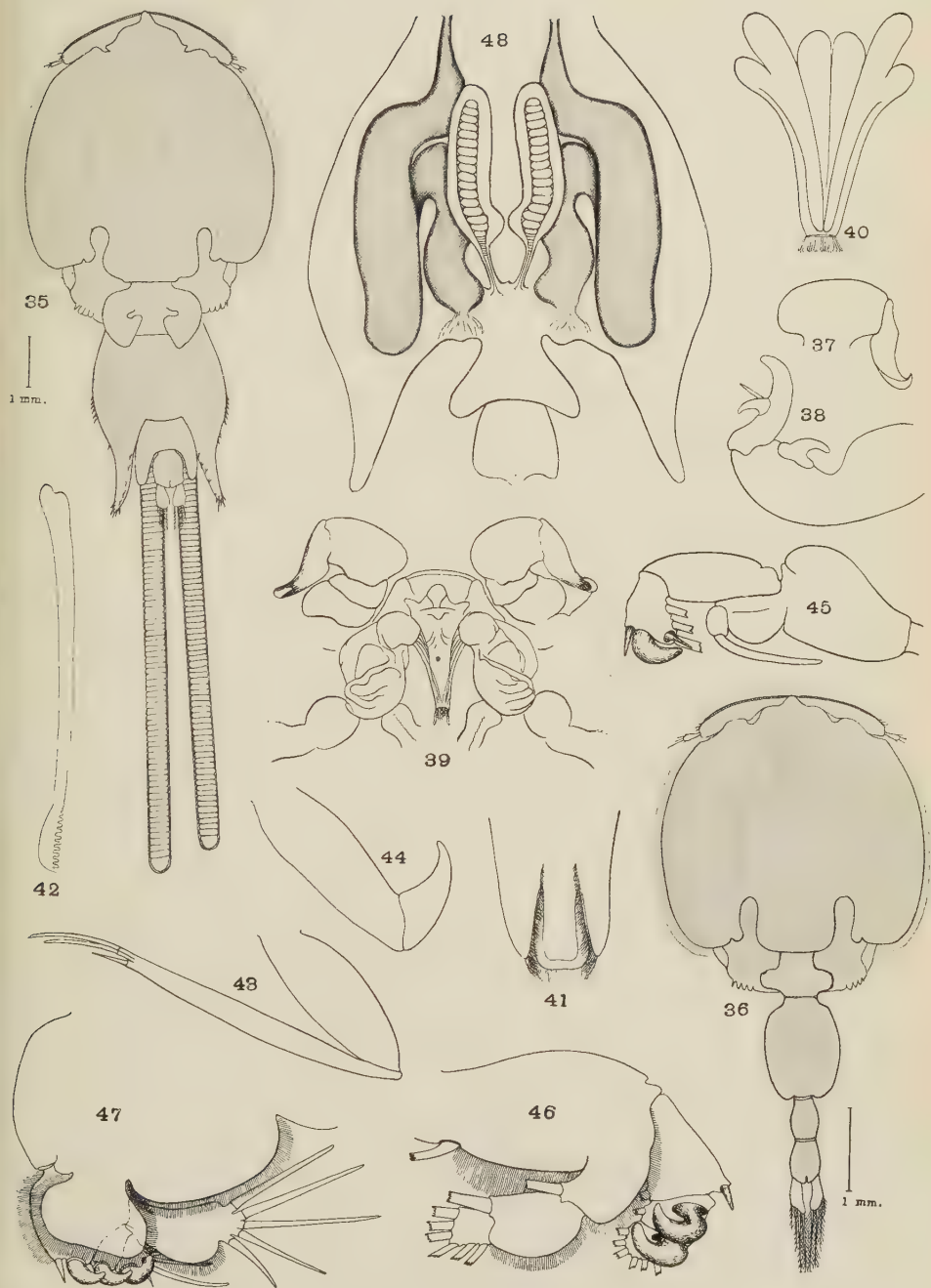




THE FEMALE OF *GLOIOPOTES ORNATUS*.

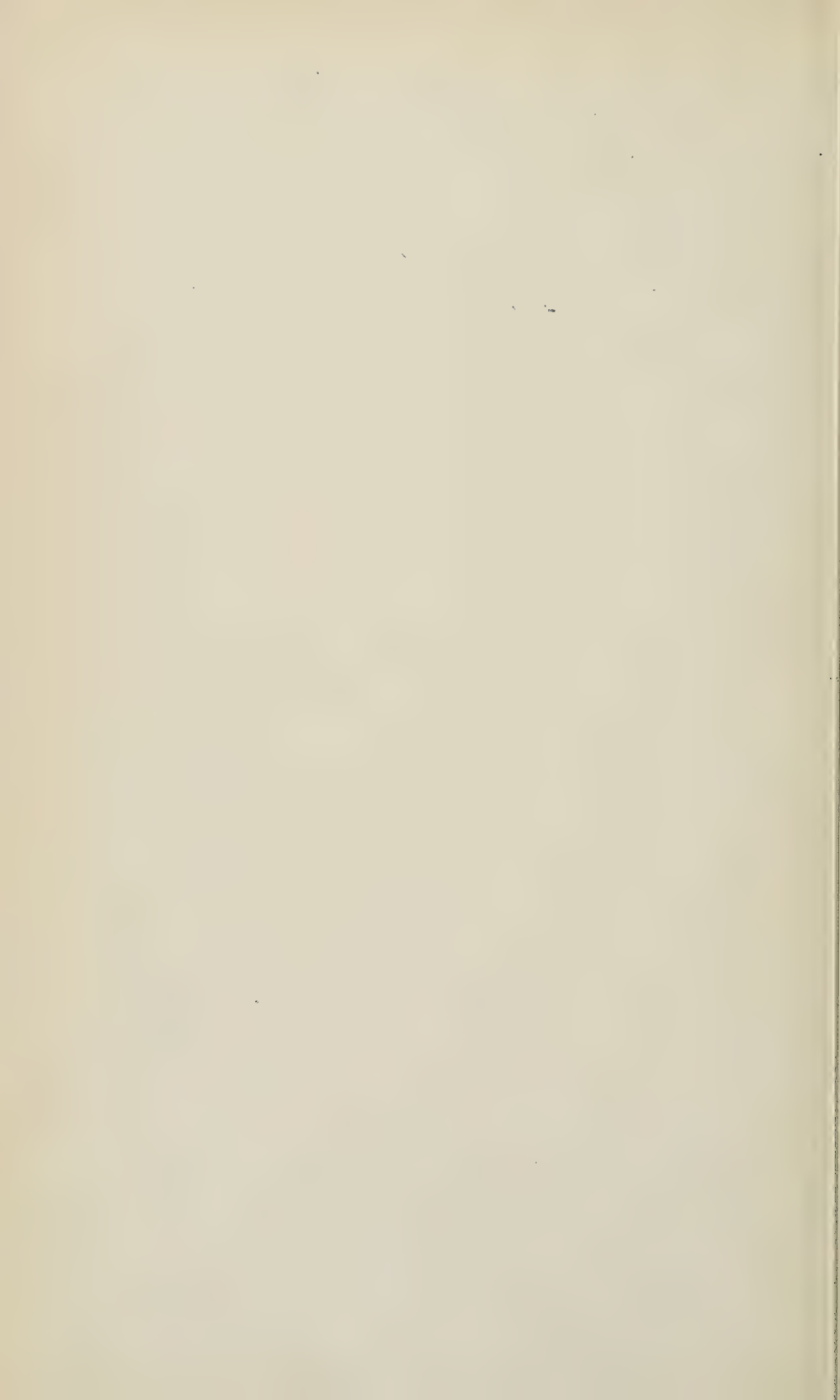
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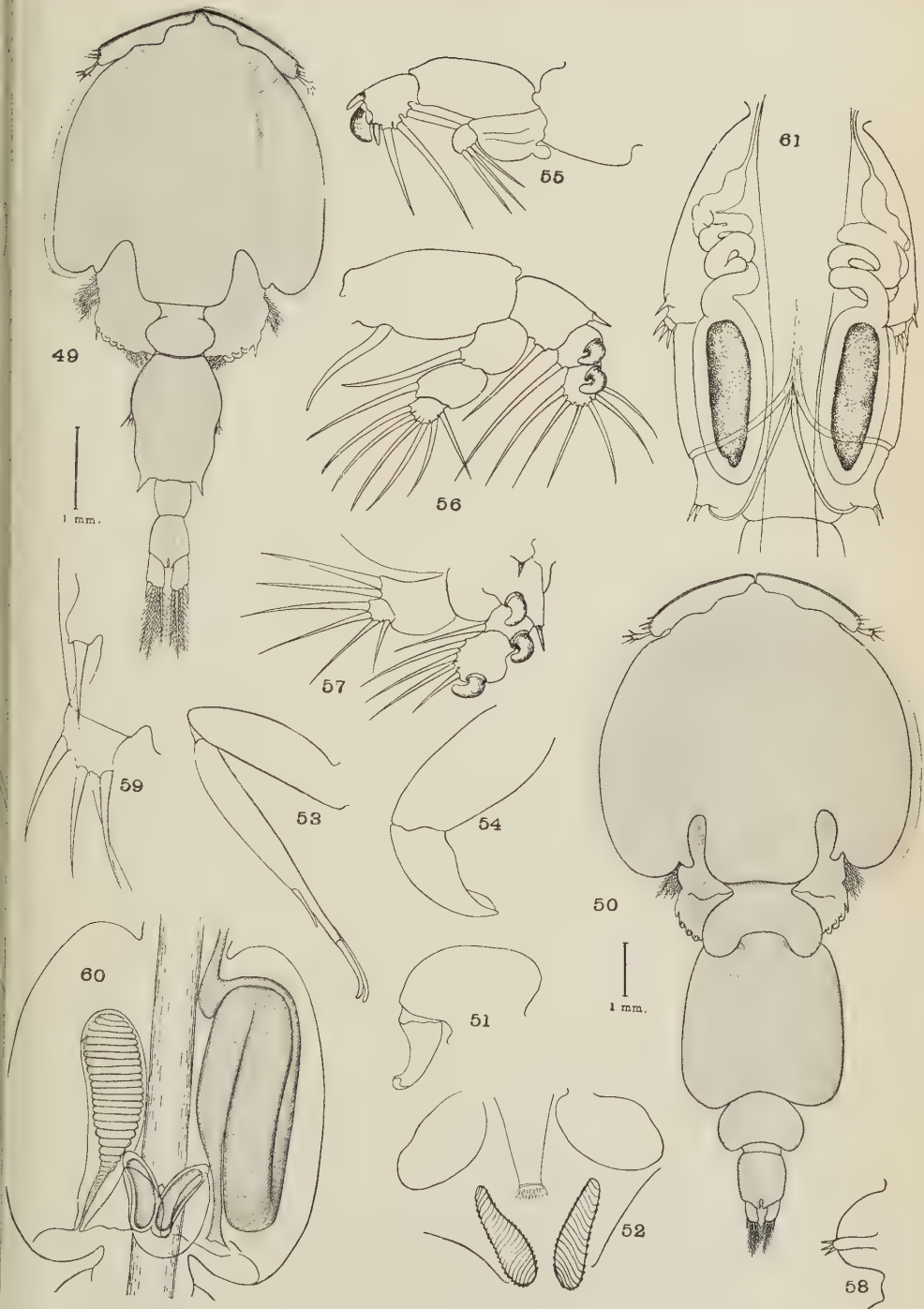


THE MALE AND FEMALE OF ALEBION GRACILIS.

FOR EXPLANATION OF PLATE SEE PAGE 720.

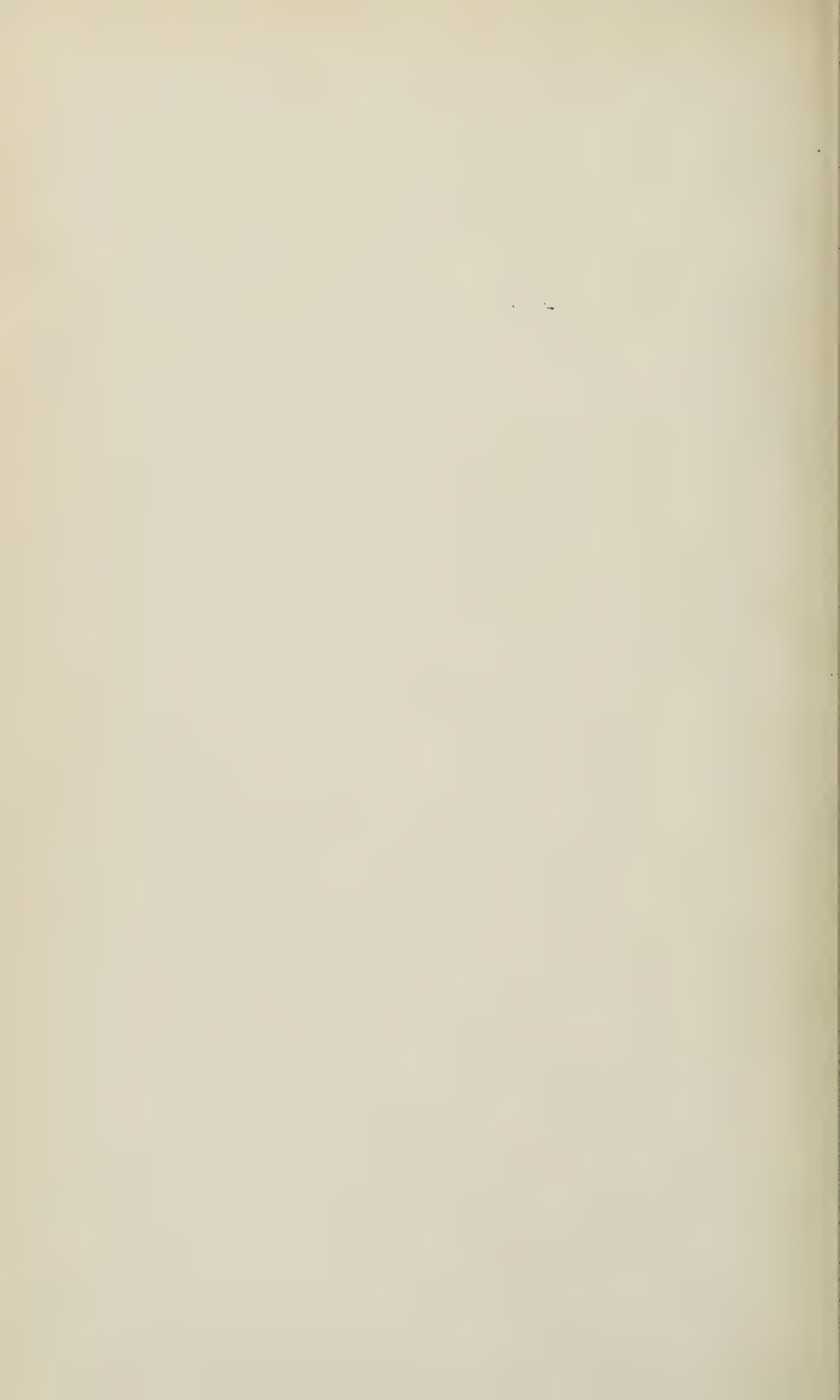


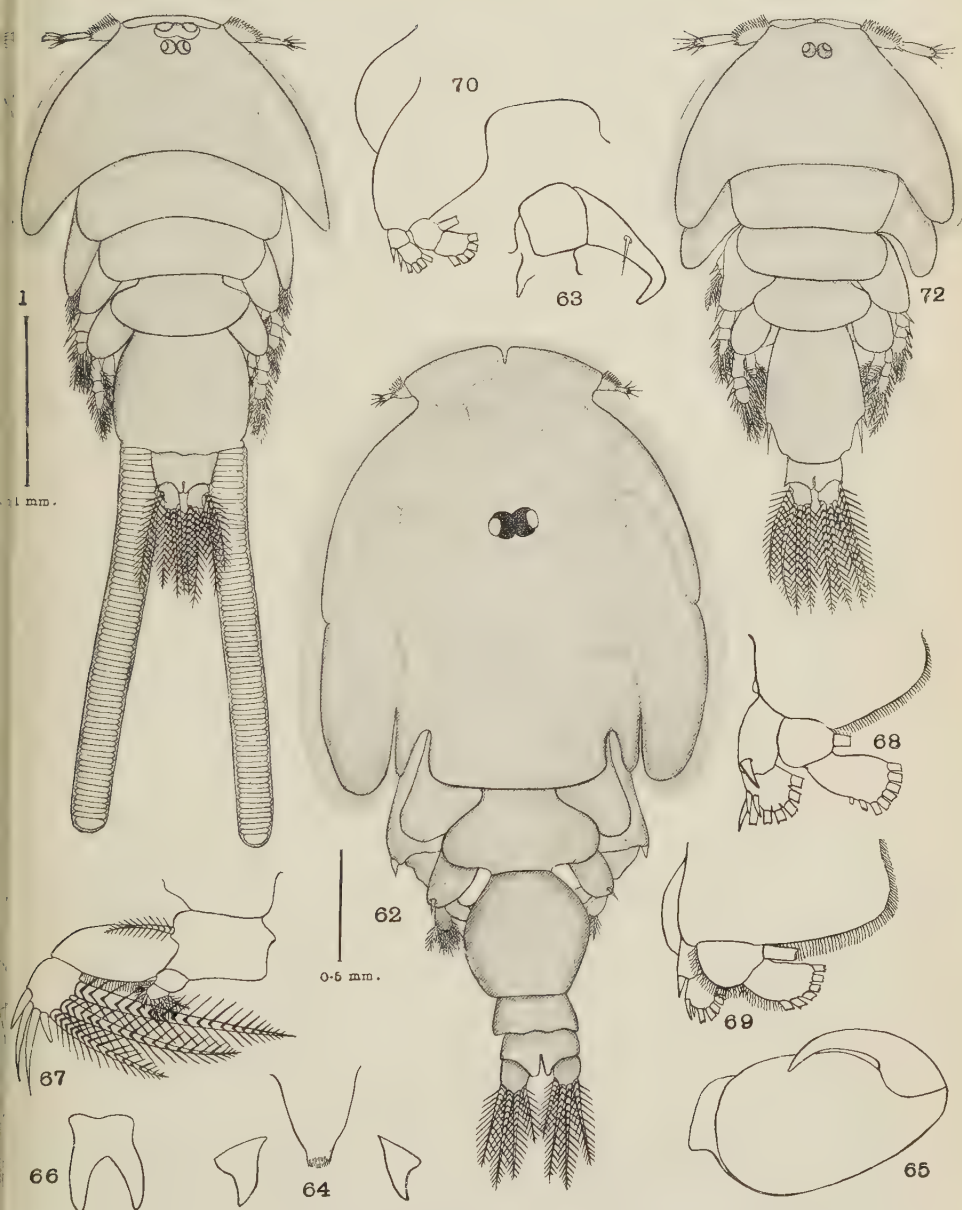




THE MALE AND FEMALE OF ALEBION GLOBER.

FOR EXPLANATION OF PLATE SEE PAGE 720.





THE MALE OF *DYSGAMUS ARIOMMUS* AND THE MALE AND FEMALE OF *DISSONUS SPINIFER*.

FOR EXPLANATION OF PLATE SEE PAGE 720.





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